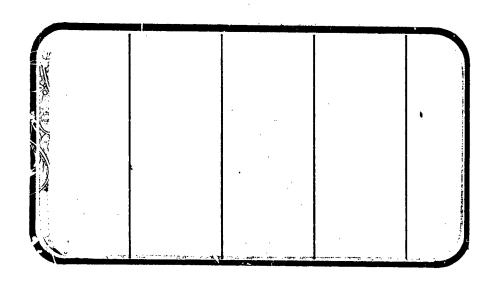


# MATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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4619



(NASA-CR-144619) TERMINAL AREA ENERGY MANAGEMENT REGIME INVESTIGATIONS UTILIZING AE C. 130-SCALE MODEL (47-0) OF THE SPACE SHUTTLE VEHICLE ORBITER CONFIGURATION 140A/B/C/R IN THE AMES RESEARCH CENTER 11 X G3/02 49183

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AEROTHERMODYNAMIC DATA REPORT



JOHNSON SPACE CENTER

HOUSTON, TEXAS

DATA MANagement services



DMS-DR-2254 NASA CR-144,619 VOLUME 1 OF 13

TERMINAL AREA ENERGY MANAGEMENT
REGIME INVESTIGATIONS UTILIZING AN 0.030-SCALE
MODEL (47-0) OF THE SPACE SHUTTLE VEHICLE
ORBITER CONFIGURATION 140A/B/C/R IN THE
AMES RESEARCH CENTER 11 X 11 FOOT
TRANSONIC WIND TUNNEL (0A148)

by

P. J. Hawthorne Rockwell International Space Division

Prepared under NASA Contract Number NAS9-13247

by

Data Management Services Chrysler Corporation Space Division New Orleans, La. 70189

for

**Engineering Analysis Division** 

Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas

#### WIND TUNNEL TEST SPECIFICS:

Test Number:

ARC 11-073

NASA Series Number:

0A148

Model Number:

47-0

Test Dates:

Occupancy Hours:

May 5 through May 17, 1975

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Chrysler Corporation Space Division assumes no responsibility for the data presented other than display characteristics.

TERMINAL AREA ENERGY MANAGEMENT

REGIME INVESTIGATIONS UTILIZING AN 0.030-SCALE

MODEL (47-0) OF THE SPACE SHUTTLE VEHICLE

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#### **ABSTRACT**

This report documents data obtained in wind tunnel test OA148. The objectives of the test series were to:

- 1) obtain pressure distributions, forces and moments over the vehicle 5 Orbiter in the terminal area energy management (TAEM) and approach phases of flight.
- 2) obtain elevon and rudder hinge moments in the TAEI and approach phases of flight.
- 3) obtain body flap and elevon loads for verification of loads balancing with integrated pressure distributions.
- 4) obtain pressure distributions near the short OMS pods in the high subsonic, transonic and low supersonic Mach number regimes.

Testing was conducted over a Mach number range from 0.6 to 1.4 with Reynolds number variations from 4.57 x  $10^6$  to 2.74 x  $10^6$  per foot. Model angle-of-attack was varied from -4 to 16 degrees and angles of side slip ranged from -8 to 8 degrees.

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- A) CY, CYN and CBL versus BETA
- B) CN, CA and CLM versus ALPHA
- C) CHEO, CHEI, CHETOT and CHBF versus ALPHA
- D) CP versus X/LB
- CP versus X/CW

E

CP versus X/CV

## NOMENCLATURE

Symbol Symbol	Plot Symbol	Definition
A <sub>b</sub>	AB	total Orbiter base area, ft <sup>2</sup>
Ai	Ai	area over which P <sub>i</sub> acts, ft <sup>2</sup>
A <sub>sb</sub>	ASB	speed brake base area, ft <sup>2</sup>
b	BREF, BW	Orbiter wing span, in
b <sub>V</sub>	BV	vertical tail reference span, in
$c_{A_u}$	CAU	Orbiter uncorrected axial force coefficient
CA	CA	Orbiter axial force coefficient with sting cavity adjusted to average base pressure
CAF	CAF	Orbiter forebody axial force coefficient.
CAsc	CASC	Orbiter sting cavity axial force coefficient.
$c_{D_{\overline{U}}}$	CDU	Orbiter uncorrected drag coefficient
c <sub>hbf</sub>	CHBF	body flap hinge moment coefficient, about hinge line $X_0 = 1532.0$
<sup>C</sup> hei	CHEI	inner elevon hinge moment coefficient, about hinge line $X_0 = 1387.0$
C <sub>heo</sub>	CHEO	outer elevon hinge moment coefficient, about hinge line $X_0 = 1387.0$
с <sub>Не</sub> тот	CHETOT	total right elevon hinge moment coefficient
$c_{L_{U}}$	CLU	Orbiter uncorrected lift co officient
C <sub>2</sub>	CBL	Orbiter rolling moment coefficient, body axis system

## NOMENCLATURE (Continued)

Symbol .	Plot Symbol	Definition
c <sub>m</sub>	CLM	Orbiter pitching moment coefficient with sting cavity adjusted to average base pressure, referenced to Orbiter MRC.
$c_{m_u}$	CLMU	Orbiter uncorrected pitching moment coefficient
$c^{m}$	CLMF	Orbiter forebody pitching moment coefficient referenced to orbiter MRC.
c <sub>msc</sub>	CLMSC	Orbiter sting cavity pitching moment coefficient, referenced to Orbiter MRC
$c_{N_u}$	CNU	Orbiter uncorrected normal force coefficient
C <sub>N</sub>	CN	Orbiter normal force coefficient with sting cavity adjusted to average base pressure
$c_{N_{\overline{F}}}$	CNF	Orbiter forebody normal force coefficient
CNsc	CNSC	Orbiter sting cavity normal force coefficient
c <sub>n</sub>	CYN	Orbiter yawing moment coefficient, body axis system
C <sub>pi</sub>	CPi	surface tap pressure coefficient, port i, $(P_i - P_{\infty})/q$
Сү	CY	Orbiter side force coefficient
c[x][x]	c[x][Y]	base area force and moment coefficients. The first subscript (post fix) designates the type of coefficient, the second the pressure tap and it's associated area. The symbolic vectors [X] and [Y] are defined below.
[X]=	:	vectors [n] and [r] are derined below.
A N Y m n	A N Y I.M YN BL	axial force normal force side force pitching moment yawing moment rolling moment

# NOMENCLATURE (Continued)

Symbol	Plot Symbol	Definition
[Y]	<b>a</b>	
1,2,3 4,5,6 sc bf	1,2,3 4,5,6 SC BF	areas associated with pressure taps 1 through 6 see figure 2b sting cavity area upper body flap area
1 <sub>b</sub>	LB	Orbiter reference body length, IML nose to $X_0 = 1528.3$ , in.
<sup>2</sup> REF	LREF	longitudinal reference length, Orbiter mean aerodynamic chord, in
	LU/DU	uncorrected lift to drag ratio, CLU/CDU
M	MACH	freestream Mach number
Φ	PHI	angular cylindrical coordinate position around Orbiter body - deg.
P <sub>i</sub>	Pi	pressure at surface tap i, PSF
P <sub>∞</sub>	P	freestream static pressure, PSF
Pt	PT	freestream total pressure, PSF
q	Q	freestream dynamic pressure, PSF
	RN/L	unit Reynolds number, million per foot
S	SREF	wing reference area, ft <sup>2</sup>
Tt	TTR	freestream total temperature, °R
X <sub>cp</sub>	XCP/L	center of pressure location referred to $1_{\mbox{\scriptsize b}}$
X <sub>o</sub> /L <sub>o</sub>	X/LB	longitudinal location of body surface, fraction of body length

# NOMENCLATURE (Concluded)

Symbol	Plot Symbol	Definition
X/C	X/CW	chordwise location on wing surface, fraction of local chord
X/C <sub>V</sub>	X/CV	chordwise location on vertical tail, fraction of local chord
n <sub>V</sub>	Z/BV	spanwise location on vertical tail, fraction of vertical tail span
η	2Y/BW	spanwise location on wing, fraction of semi span
X <sub>mrp</sub>	XMRP	longitudinal location of moment reference point
XT	хт	longitudinal moment transfer distance from Orbiter balance center to Orbiter MRC, in
Ymrp	YMRP	lateral location of moment reference point
Z <sub>T</sub>	ZT	vertical moment transfer distance from Orbiter balance center to Orbiter MRC, in
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
<sup>δ</sup> bf	BDFLAP	body flap deflection, degrees
δ <sub>eL</sub>	ELVN-L, L-ELVN	left elevon deflection, degrees
<sup>δ</sup> eR	ELVN-R, R-ELVN	right elevon deflection, degrees
<sup>6</sup> r	RUDDER	rudder deflection, degrees
δsb	SPDBRK	speed brake deflection, degrees
Z <sub>mrp</sub>	ZMRP	vertical location of moment reference point
	\$\$	mask character used to indicate all possible values for this test 01 through 85

#### REMARKS

During the course of the test it was necessary to replumb the scanivalves. The resultant time loss necessitated deleting the priority 4 runs which incorporated the use of the metric vertical tail.

Data obtained from pressure taps 184, 296 and 347 are suspect due to slow leaks noticed while leak checking individual model pressure taps.

Body flap hinge moment data for datasets RE8001 through RE8005 have a -15% drift while datasets RE8006 and RE8007 have a +10% drift down water recording system errors. System checks during the remaining of the test indicate a system error of less than 4% for body flap hinge moment data.

Rolling moment data has an approximate -.003 bias in the coefficient. The reason for this was not determined, but possible sources are fabrication tolerances and/or differential stiffness of the left and right elevon panels.

Distortion of the instrumented elevon shaft appears to have occurred around run 310 due to model assembly difficulties and the maximum loads encountered at these test conditions. A comparison of measured elevon deflection before and after the test with the nominal setting is presented below:

Elevon Panel	Nomina 1	Pre-Test	Post-Test
Inboard right	$\begin{cases} -10 \\ -4 \\ 0 \\ 4 \\ 10 \end{cases}$	-9° 36' -3° 34' +0° 10' +4° 26' +10°32'	-8° 55' -2° 55' +1° 02' +4° 28' +10°39'
Outbcard right	$\begin{cases} -10 \\ -4 \\ 0 \\ 4 \\ 10 \end{cases}$	-9° 36' -3° 34' +0° 10' +4° 26' +10°32'	-8° 15' -2° 20' +1° 05' +3° 59' +10°18'

<sup>\*</sup> Inboard only was measured but was the same as outboard panel(see Ref 2)

#### CONFIGURATION INVESTIGATED

0. 1

The Rockwell International model 47-0 Space Shuttle Orbiter Vehicle was utilized in this test series. The model was originially constructed to -140A/B lines, but was modified prior to this test with the addition of the -140C OMS pods, six inch bevelled interpanel elevon gaps and uncovered RCS forward thrustor parts. To denote these additions, the additional designations "C" (for -140C OMS pods) and "R" (for RCS thrustors) were added, and the slashes deleted for convenience on Table II(designated "-140 ABCR").

In data sets RE8069 to 085 the RCS thrustor ports in the nose were filled reverting the configuration to -140A/B/C modified with body  $B_{26}$ .

The following nomenclature denotes the model components:

Component	<u>Description</u>
B <sub>26</sub>	140A/B fuselage (VL70-000140A, VL70000140B)
B <sub>70</sub>	140A/B fuselage (VL70-000140A, VL70-000145, VL70-000140B, VL70-000143A, VL70-000139) with RCS thrustor parts (VL70-08501, VL70-08502, VL70-08296)
c <sub>9</sub>	140A/B basic canopy (VL70-000140A, VL70-000143A)
E <sub>44</sub>	140A/B elevons (VL70-000200, VL70-006089, VL70-006092) with six inch bevelled interpanel gaps, no flipper door
F <sub>9</sub>	140A/B body flap (VL70-000140B, VL70-000200)
M <sub>16</sub>	OMS-RCS pods for 1400 Orbiter
N <sub>28</sub>	OMS basic nozzles
R <sub>5</sub>	basic Orbiter rudder (VL70-000146A, VL70-000095)
v <sub>8</sub>	basic Orbiter vertical tail (VL70-000140A, VL70-000146A)
W116	basic 140A/B wing (VL70-000140B, VL70-000200)

# CONFIGURATIONS INVESTIGATED (Concluded)

# Designated configurations are:

-140ABCR =  $B_{70}$   $C_9$   $E_{44}$   $F_9$   $M_{16}$   $N_{28}$   $R_5$   $V_8$   $W_{116}$ 

-140 ABC =  $B_{26} C_9 E_{44} F_9 M_{16} N_{28} R_5 V_8 W_{116}$ 

#### TEST FACILITY DESCRIPTION

The Ames Research Center Unitary Plan 11- by 11-Foot Transonic Wind Tunnel is a closed-circuit, air-medium, variable-density facility capable of attaining Mach numbers from 0.6 to 1.4 at Reynolds numbers from 1.7 x  $10^6/\mathrm{ft}$  to 9.4 x  $10^6/\mathrm{ft}$ . The test section is 22 feet long, and models are installed on internal strain-gauge balances mounted to sting-type support systems.

Shadowgraph and Schlieren photographic equipment is available, ard pressure transducer instrumentation is provided.

Tunnel operating temperature is 580°R. Extended high Reynolds number runs are restricted by power availability.

#### DATA REDUCTION

Standard NASA/Ames data reduction equations were c.ed to reduce forces, moments, and pressures to coefficient form. Orbiter main balance force and moment coefficients were computed using the following equations:

Symbol .	Orbiter main balance measurement
NF AF PM YM SF RM	Normal Force Axial Force Pitching Moment Yawing Moment Side Force Rolling Moment
$C_{A_U} = AF / (q S)$	$C_{L_u} = C_{N_u} \cos \alpha - C_{A_u} \sin \alpha$
$c_{N_u} = NF / (q S)$	$C_{D_u} = C_{N_u} \sin \alpha + C_{A_u} \cos \alpha$
$C_{\gamma} = SF / (q S)$	
$C_{m_u} = \frac{PM}{qS_c} + \frac{C_A \cdot Z_T}{c}$	$\frac{c_N \cdot x_T}{c}$
$C_{\ell} = \frac{R M}{qS_b} + \frac{C_{\gamma} \cdot Z_{T}}{b}$	Moment Transfer Distances $X_T = 0.572 \text{ in.}$
$C_n = \frac{\gamma_M}{qS_b} - \frac{C\gamma \cdot \chi_T}{b}$	$Y_{T} = 0$ $Z_{T} = 0.450 \text{ in.}$

The Moment Reference Center about which the data was reduced is located at

Balance coefficients were grouped into datasets RE80\$\$.

Hinge moments and hinge moment coefficients were computed using the following equations:

Elevon hinge moments (inboard and outboard).

$$HM_{e_{I}} = (HM1-HM2) (M1/D1) + HM1$$

$$HM_{eo} = (HM3-HM4) (M3/D3) + HM3$$

where

HMi = measured moment on strain gage i

D1 = distance between gages 1 and 2, .49335 in.

D3 = distance between gages 3 and 4, .45800 in.

M1 = moment transfer distance for inboard elevon, .93825 in.

M3 = moment transfer distance for outboard elevon, .92250 in.

Elevon hinge moment coefficients

Inboard, 
$$C_{H_{e_I}} = H_{M_{e_I}} / (q S_e c_e)$$

Outboard, 
$$C_{H_{eo}} = H_{M_{e_o}} / (q S_e c_e)$$

Total, 
$$C_{H_{e_{TOT}}} = C_{H_{e_I}} + C_{H_{e_O}}$$

 $S_e$  = elevon reference area, 0.189 ft.<sup>2</sup>

 $c_e$  = elevon reference MAC, 2.721 in.

Body flap hinge moment coefficient

$$C_{H_{bf}} = HM_{bf} / (q S_{bf} c_{bf})$$

 $HM_{bf}$  = measured body flap hinge moment

S<sub>bf</sub> = body flap reference area, 0.12834 ft.<sup>2</sup>

cbf = body flap reference MAC, 2.541 in.

Hinge moment coefficients are part of datasets RE8X\$\$.

Pressure coefficients for all model orifice pressure measurements were computed using this equation:

$$C_{P_i} = (P_i - P_{\infty})/q$$

where  $P_i$  = pressure at model orifice i

 $P_{\infty}$  = tunnel static pressure

q = tunnel dynamic pressure

Other data reduction constants include:

 $S = wing reference area, 2.4210 ft.^2$ 

c = wing reference chord, 14.2443 in.

b = wing reference span, 28.1004 in.

After the data had been reduced to coefficient form by NASA/AMES, DMS interpolated it to nominal  $\alpha$ 's and  $\beta$ 's. Then 2 types of base and sting cavity area coefficients were calculated. When they are applied 3 types of balance coefficient data exists. These can be distinguished by the last subscript (symbolic name) or postfix (mnemonic name). The key is given below

- U ~ uncorrected coefficients.
  - coefficients with sting cavity pressure corrected to base pressure (without a suffix).
- F ~ forebody coefficients with the base area pressure corrected to freestream pressure.

Only the correction coefficient associated with base pressure tapes 1 through 4 were applied to the longitudinal orbiter coefficients.

Figure 2b illustrates the base area associated with each pressure tap. Alphabetic characters bf and sc designate body flap and sting cavity areas, respectively. Base area coefficient names have a numeric character which designates the pressure tap number. Base coefficients for vertical tail areas 5 and 6 were calculated but not applied to the total orbiter coefficients. Base area coefficient values are tabulated in the appendix. A detailed derivation of these coefficients follows. It is concluded by a matrix of base area geometric properties.

The orbiter sting cavity force and moment coefficients were computed as:

$$C_{A_{SC}} = \frac{(C_{p2} - C_{p1})}{S} A_{1}$$

$$C_{N_{SC}} = \frac{(C_{p2} - C_{p1})}{S} A_{1} \tan 12.55^{\circ}$$

$$C_{m_{SC}} = C_{A_{SC}} \frac{Z_{t}}{C} - C_{N_{SC}} \frac{X_{SC}}{C}$$

The orbiter force and moment coefficients corrected for the difference between balance cavity pressure and orbiter base pressure:

$$C_A = C_{A_u} - C_{A_{SC}}$$
 $C_N = C_{N_u} - C_{N_{SC}}$ 
 $C_m = C_{m_u} - C_{m_{SC}}$ 

These orbiter coefficients are part of datasets KE80\$\$.

Orbiter base force and moment coefficients were calculated as follows:

Upper base area

$$C_{N2u} = -(C_{p2} A_{2u} \tan 16^{\circ})/S$$

$$C_{A2u} = -(C_{p2} A_{2u})/S$$

$$C_{m2u} = \frac{C_{A2u} Z_{2u}}{c} - \frac{C_{N2u} X_{2u}}{c}$$

Lower base area

$$C_{N2_{\ell}} = -(C_{p2} A_{2_{\ell}} \tan 10^{\circ})/S$$

$$C_{A2_{\ell}} = -(C_{p2} A_{2_{\ell}})/S$$

$$C_{m2_{\ell}} = C_{A2_{\ell}} \frac{Z_{2\ell}}{c} - C_{N2_{\ell}} \frac{X_{2\ell}}{c}$$

Total base area, A2

$$c_{N2} = c_{N2u} + c_{N2g}$$

$$C_{A2} = C_{A2_u} + C_{A2_\ell}$$

$$C_{m2} = C_{m2_u} + C_{m2_g}$$

OMS pod base area, A3

(This assumes the surface is perpendicular to the orbiter X-axis)

$$C_{A3} = -(C_{p3} \Lambda_3)/S$$

$$C_{m3} = C_{A3} \frac{Z_3}{C}$$

OMS pod base area, A<sub>4</sub>

(This assumes the surface is perpendicular to the orbiter X-axis)

$$C_{A4} = -(C_{p4} A_4)/S$$

$$C_{m4} = C_{A4} \frac{Z_4}{C}$$

Coefficients for the above areas are grouped into datasets EE8D\$\$.

Upper surface of body flap

$$C_{Abf} = \frac{-C_{pbf} Abf}{S} \sin (\delta_{bf} + 6.88^{\circ})$$

$$C_{Nbf} = \frac{-C_{pbf} Abf}{S} \cos (\delta_{bf} + 6.88^{\circ})$$

$$C_{mbf} = \frac{C_{Abf} Z_{bf}}{C} - \frac{C_{Nbf} X_{bf}}{C}$$

where:

$$C_{pbf} = \frac{C_{p200} + C_{p201} + C_{p204} + C_{p205}}{4}$$

The orbiter force and moment coefficients adjusted to free stream pressure (forebody coefficients).

$$C_{A_{F}} = C_{A_{U}} - \left(\frac{-C_{p1} A_{1}}{S} + \sum_{i=2}^{4} C_{A_{i}} + C_{A_{b}f}\right)$$

$$C_{N_{F}} = C_{N_{U}} - \left(C_{N_{2}} + C_{N_{b}f}\right)$$

$$C_{m!} = C_{mU} - \left(\sum_{i=2}^{4} C_{m_{i}} + C_{m_{b}f}\right)$$

These orbiter coefficients are part of datasets KE80\$\$.

Vertical tail "undercarriage" area,  $A_5$ 

Top Segment:

$$C_{N5t} = (C_{p5} A_{5t} \tan 63.75^{\circ})/S$$

$$C_{A5t} = -(C_{p5} A_{5t})/S$$

$$C_{m5t} = C_{A5t} \frac{Z_{5t}}{C} - C_{N5t} \frac{X_{5t}}{C}$$

#### Middle Segment:

$$C_{N5m} = (C_{p5} A_{5m} \tan 26.1426^{\circ})/S$$

$$C_{A5m} = - (C_{p5} A_{5m})/S$$

$$C_{m5m} = C_{A5m} \frac{Z_{5m}}{c} - C_{N5m} \frac{X_{5m}}{c}$$

#### **Bottom Segment:**

$$C_{N5b} = (C_{p5} A_{5b} tan 21.94^{\circ})/S$$

$$C_{A5b} = - (C_{p5} A_{5b})/S$$

$$c_{m5b} = c_{A5b} \frac{z_{5b}}{c} - c_{N5b} \frac{x_{5b}}{c}$$

## Total area, A<sub>5</sub>:

$$C_{M5} = C_{m5t} + C_{m5m} + C_{m5b}$$

## Vertical Tail base area, A6:

## Segment above rudder

$$C_{N6u} = (C_{p6} A_{6u} tan 63.75^{\circ})/S$$

$$C_{A6u} = (C_{p6} A_{6u})/S$$

$$C_{m6u} = C_{A6u} \frac{Z_{6u}}{C} - C_{N6u} \frac{X_{6u}}{C}$$

#### Rudder/Speed brake base:

$$C_{A6_{\ell}} = C_{P6} A_{6_{\ell}} [sin (\theta-55.1667^{\circ}) cos 55.1667^{\circ} + cos (\theta-55.1667^{\circ}) sin 55.1667^{\circ} cos (8r)]/S$$

$$C_{N6_{\ell}} = C_{p6} A_{6_{\ell}} Lsin (\theta-55.1667^{\circ}) sin 55.1667^{\circ} - cos (\theta-55.1667^{\circ}) cos 55.1667^{\circ} cos (8r)]/S$$

$$C_{Y6_{\ell}} = C_{p6} A_{6_{\ell}} cos (\theta-55.1667^{\circ}) sin 8r/S$$

$$C_{m6_{\ell}} = [C_{A6_{\ell}} (Z_{6_{\ell}}) - C_{N6} (X_{6_{\ell}})]/C$$

$$C_{\ell} = [C_{Y6_{\ell}} (Z_{6_{\ell}})]/b$$

$$C_{n6_{\ell}} = [C_{Y6_{\ell}} (X_{6_{\ell}})]/b$$

$$C_{n6_{\ell}} = -[C_{Y6} (X_{6_{\ell}})]/b$$

$$A_{6_{\ell}} = A_{6_{\ell}}/sin 0$$

# Total area, A<sub>6</sub>:

$$C_{A6} = C_{A6u} + C_{A6k}$$

$$C_{N6} = C_{N6u} + C_{N5k}$$

$$C_{Y6} = C_{Y6k}$$

$$C_{m6} = C_{m6u} + C_{m6k}$$

$$C_{k6} = C_{k6k}$$

$$C_{n6} = C_{n6k}$$

Vertical tail area coefficient data are grouped into datasets GE8D\$\$.

BASE GEOMETRIC PROPERTIES MATRIX

			Distance between Centroid and MRC	entroid and MRC
Description	Sub- script	Area A - ft.²	vertical Z ~ in.	longitudinal X ~ in.
Sting cavity	SC	0.076699	0.45	12.199
Body flap upper surface	bf	0.128	- 2.64	13.659
Orbiter balance cavity	-	0.076699	0.45	12.199
Orbiter base orifice 2 lower	22	0.133889	- 1.32	12.617
Orbiter base orifice 2 upper	2n	0.0818055	2.07	12.384
Lower OMS pod	ო	0.030472	2.68	AN
Upper OMS pod	4	0.074166	3.63	NA.
Vertical tail "undercarriage" bottom	<b>2</b> p	0.003565	4.612	12.395
Vertical tail "undercarriage" middle	<b>2</b>	0.002610	5.336	14.079
Vertical tail "undercarriage" top	<b>5</b> t	0.000341	5.97	15.185
Vertical tail above rudder	n9	0.000798	12.656	18.482
Base area of speed brake	99	Varies with sp	Varies with speed brake deflection	

NOTES: Sting cavity and Orbiter balance cavity are synonymous.

NA - not applicable.

<u>6sb</u>	Λ6 <sub>ℓ</sub> ft'
0 25 35 55 85	0.0066036 0.0456000 0.0621000 0.0950800 0.1551400
x <sub>61</sub> =	15.045 + 1.442277 [1-cos (&sb/2)]
Z <sub>62</sub> =	9.755 + 0.501827 [1-cos (&sb/2)]

Standard DMS loads cycle test procedures were used to process the OA148 pressure data. First numerous pressure distribution plots were released. Analysis of these produced bad pressure data list. This list is reproduced below:

OA148 Bad Pressure Data

Component	Dataset <u>No.</u>	Tap <u>No.</u>	B	ā
Fuselage (B)	1 1 1 1 1 1 1	143 148 150 152 186 187 189 191	4 4 4 4 4 4 4	-4 -4 -4 -4 -4 -4
Lower Wing (L)	1 + 7 1 + 85 1 1 1 1 1	231 290 316 317 337 338 358 378 379 398	ALL 4 4 4 4 4 4	ALL -4 -4 -4 -4 -4 -4
Upper Wing (U)	1 + 7 1	247 357	ALL 4	ALL -4
Body Flap (F)	24	205	-4	12
Speed Brake (K)	1 + 85	822	ALL	ALL
Vertical Tail (V)	8 ALL 79 79	443 1444 1453 1454	ALL ALL -4 -4	ALL ALL -4 -4

Note: Wind tunnel pressure data tabulated in the appendix have the original bad data values.

These points were eliminated from further processing. The remaining data were interpolated to nominal alpha and beta values. Processing was completed with the release of a magnetic tape containing the final interpolated pressure coefficients.

This report contains plots and tabular listings for both force and pressure data. Plotted force data illustrates lateral-directional, longitudinal and hinge moment characteristics of the configuration tested. Plotted pressure data illustrates the effect of several control deflections and attitude changes on local pressure distributions. The multiple volume appendix contains a tabulated listing of the basic force and pressure data. Listing of the interpolated base area coefficients is also included. The plotted and tabulated data are arranged in the following manner:

VOLUME NO.	CONTENTS
1	Force data plots showing lateral-directional
	longitudinal and hinge moment characteristics.
2	Plots illustrating the effect of control surface
	deflections on fuselage, wing and vertical tail
	pressure distributions.

# DATA REDUCTION (Concluded)

VOLUME		
NO.		CONTENTS
3	Tabulated	Force Data
	Dataset	Data type
	RE80\$\$	source balance coefficients
	RE8X\$\$	source hinge moment coefficients
	RE8Y\$\$	source base pressure coefficients
	а	interpolated balance coefficients adjusted for cavity pressure and forebody coefficients
	EE8D\$\$ i	nterpolated base and cavity area coefficients
	GE8D\$\$ i	nterpolated vertical tail base

## Tabulated Pressure Data

	Component	Fourth Character*	<u>Page</u>
4, 5	orbiter fuselage	В	1
6,7,8	lower wing	L	1271
9,10,11	upper wing	U	3147
12 12	upper body flap lower body flap	F G	5405 5774
13 13	speed brake vertical tail	K V	6143 6547

<sup>\*</sup> The fourth character in each dataset identifier (i.e., XE8BXX, B for Fuselage) represents the individual component.

#### REFERENCES

- 1. SD75-SH-0106, "Pretest Information for OA148 of the 0.03-Scale 47-0 Pressure Loads Space Shuttle Model in the 11 x 11 Foot Leg of the NASA/ARC Unitary Plan Wind Tunnel," April 18, 1975.
- 2. MG-75-07-11, Rockwell International Corporation Internal Letter: "Model design Dimensional Varification Task 36: Elevon Deflection Angle Check of the 0.03-Scale SSV Model 47-0 (140A/B Configuration)". SAS/WT0/75-283, July 29, 1975.

TEST : OA148			DATE : May 1975
	TEST CON	NDITIONS	
	REYNOLDS NUMBER	DYNAMIC PRESSURE	STAGNATION TEMPERATURE
MACH NUMBER	(per foot)	(pounds/sq. inch)	(degrees Fahrenheit)
0.60	4.57 x 10 <sup>6</sup>	4.166	120
0.90	3.41 x 10 <sup>6</sup>	4.166	120
1.10	3.05 x 10 <sup>6</sup>	4.166	120
1.25	$2.86 \times 10^6$	4.166	120
1.40	$2.74 \times 10^6$	4.166	120
		: 	
BALANCE UTILIZED:	ARC Task MK XX	A	
	CAPACITY:	ACCURACY:	COEFFICIENT TOLERANCE:
NF	<u>3000 lbf/gage</u>		
SF	1500 1bf/gage		
AF	. 600 1bf	<del></del>	
PM	27.000 in-1bf	4	
RM	4000 in-1bf		
YM	10,500 in-1bf		<del></del>
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ARC 11-07B

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	48	, 1		<b>7</b> 00	41-						- 40						140							} ,
	TEST: OA		798 65 7	IDENTIFIER	D-8071	+-,	510	374	20		20	6	5		0.00		103	262	202	480	280		,	4.00.00

# TABLE III MODEL DIMENSIONAL DATA

MODEL COMPONENT : BODY - BOX		
GENERAL DESCRIPTION :Configura	ion 140A/B orbiter	ใบรลโลฮก
No.TE: B26 is identical to B24 exce	ept underside of fuse	lage has been
refaired to accept W116.		
MODEL SCALE: 0.030 MC	DDEL DRAWING: SS-ACC	1147. Release 12
DRAWING NUMBER:VI.70=000143B, VI.70=000140A, -	-000200, -000205, -00 -000140B	06089, -000145
DIMENSIONS :	FULL SCALE	MODEL SCALE
Length (OMI: Fwd Sta. $X_0 = 2$ ) Length (IML: Fwd Sta $X_0 = 2$ )		38.799 <u>38.709</u>
Max Width (@ $X_0 = 1528.3$ ), 1	in. <u>264.0</u>	7.920
Max Depth (@ $X_0 = 1464$ ), In.	250.0	7.500
Fineness Ratio	0.264	0.264
Area - Ft <sup>2</sup>		
Max. Cross-Sectional	340.88	0.3068
Planform		
Wetted		
Bas <del>e</del>		

# TABLE III (Continued)

MODEL COMPONENT : BODY - BTO		
GENERAL DESCRIPTION:Configurat forward fuselage RCS thruster ports,	ion 140A/B orbit	er fuselage with
B <sub>26</sub> .	7/11	Identical Co
MODEL SCALE: 0.030		
DRAWING NUMBER: <u>VL70-000140A</u> -0001 VL70-000205, -00608	<u>40B000143B.</u> -	<u>-000145, -00020</u> 0, 3502, -008296
DIMENSIONS :	FULL SCALE	MUDEL SCALE
Length (OML: Fwd Sta $X_0$ =235), Length (IML: Fwd Sta $X_0$ =238),	In. 1293.3 In. 1290.3	38.799 38.709
Max Width (@ X <sub>0</sub> = 1528.3), In.		_7.920
Max Depth (@ $X_0 = 1464$ ), In.	250.0	_7.500
Fineness Ratio	0.264	0.264
Area - Ft <sup>2</sup>		
Max. Cross-Sectional	34C.88	0.3068
Planform		
Wetted		
Base		

MUDEL COMPONENT :CANOPY C9		
GENERAL DESCRIPTION : Configuration		
В26.		THE PARTY OF THE P
MODEL SCALE: 0.030 MODEL DWG:	22 22 22	
	55-A00147, Re	lease 12
DRAWING NUMBER: VI.70-000143A		
P.M. Mariana		
DIMENSIONS :	FULL SCALE	MODEL SCALE
Length $(X_0=434.643 \text{ to } 578)$ , In.	143.357	4.301
Max Width (@ $X_0 = 513.127$ ), In.	152.412	4.572
Max Depth (@ $X_0 = 485.0$ ), In.	25.00	0.750
Fineness Ratio		
Area		
Max. Cross-Sectional		
Planform		
Wetted		
Base		
Daza		

MODEL COMPONENT ELEVON - EL		
GENERAL DESCRIPTION 6.0 In. F.S.	gaps machined int	o Egg cleven.
Flipper doors centerbody pieces, and		
(Data are for one of two sides.)		
MODEL SCALE: 0.030		
DRAWING NUMBER		
DIMENSIONS	FULL SCALE	MODEL SCALE
Area – Ft <sup>2</sup>	210.0	0.189
Span (equivalent) , In.	349.2	10.476
Inb'd equivalent chord, In.	118.0	3.54
Outb'd equivalent chord, In.	_55.19	1.656
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.2096	0.2096
At Outh'd equiv. chord	0.4004	0.4004
Sweep Back Angles, degrees	<del></del>	
Leading Edge	0.00	0.00
Trailing Edge	- 10.056	- 10.056
Hingeline	0.0	0.0
(Product of Area & d Area Moment (blazzabbackadpadbuc) , F	t 1587.25	0.01,29
Mean Aerodynamic Chord, In.	90.7	2.721

MODEL COMPONENT : BODY FLAP - F	9	
GENERAL DESCRIPTION :Configura	tion 140A/B	
MODEL SCALE: 0.030		
DRAWING NUMBER: VL70-000140B, -	000200	
DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (Chord), In.	84.7	2.541
Max Width , In.	262.308	7.869
Max Depth , In.	23.00	0.690
Fineness Ratio		
Area - Ft <sup>2</sup>		
Max. Cross-Sectional		
Planform	142.60	0.128
Wetted		
Base	41.90	0.0377

MODEL COMPONENT : OMS POD - M16		
GENERAL DESCRIPTION : Configuration	140C orbiter OMS	pod - short pod
External contour is to referenced draw	vings with 1/2" a	dded to simulate
TPS.		
MODEL SCALE: 0.015		
DRAWING NUMBER : _VL70-00840100841	10	
DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (OMS Fwd Sta X <sub>O</sub> =1310.5)	,In. 258.50	7.755
Max Width (@ $X_0 = 1511$ ), In.	136.8	4.104
Max Depth (@ $X_0 = 1511$ ), In.	74.70	2.241
Fineness Ratio	2.484	2.484
Area - Ft <sup>2</sup>	,	
Max. Cross-Sectional	58.865	0.053
Planform	·	
Wetted		
Base		

MODEL COME	OMS PONENT: NOW NOW ZLES	TABLE III (CORE.Q)		
GENERAL DE	SCRIFFION: Con	figuration LLOA/B or	rbite: OMS no	zles.
-				
MODEL SCAL	E: 0.030			
DRAWING NU	MBER: <u>VL70-0001</u>	40A (Location), SS-A	00106, Releas	e 9 (Contour)
DIMENSIONS	<b>:</b>		FULL SCALE	MODEJ: SCALE
MACH N	<b>10.</b>			
Gi	- In. mbal Point to Exit roat to Exit Plane	Pl.ane		
Ex Th	er - In. it roat			
	let			
Area - Ex	rt <sup>2</sup> it			
Th	roat			
Gimbal L <b>eft</b>	Point (Station) - Nozzle	In.		
	Ϋ́O .		1518.0 - 88.0	<u>45.54</u> - 2.64
	20		492.	14.76
Right	Nozzles XO		1518.0	1.5.51.
	Υο 20		88.0	2.64 14.76
	osition - Deg.			
Left ·	Nozzle Pitch Yaw		15°49' 12°17'	15°49' 12°17'
Right	Nozzle Pitch		15°49'	15°49'
	Yaw		12°17'	12°17'

1

まれたのなるので、これが記事を

MODEL COMPONENT RUDDER - R	·	-
GENERAL DESCRIPTION Configuration 1	140C orbiter rud	der (identical to
configuration 140A/B rudder).		
MODEL SCALE: 0.030		
DRAWING NUMBER	25	
	,	
DIMENSIONS	FULL SCALE	MODEL SCALE
Area - Ft <sup>2</sup>	100.15	0.090
Span (equivalent), In.	201,00	6.030
Inb'd equivalent chord, In.	91.585	2.748
Outb'd equivalent chord, In.	50,833	1.525
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.400	0.400
At Outb'd equiv. chord	0.400	0.400
Sweep Back Angles, degrees		
Leading Edge	34.83	34.83
Trailing Edge	26.25	26.25
Hingeline (Product of area & C)	34.83	34.83
Area Moment (Microschoopeding), Ft	3 610.92	0.0165
Mean Aerodynamic Chord, In.	73.2	2.196

MODEL COMPONENT: VERTICAL - Vg		
GENERAL DESCRIPTION: Configuration 140C orbi	iter vertical to	il.
(Identical to configuration 140A/B vertical to	il.)	
MODEL SCALE: 0.030		
DRAWING NUMBER: VL70-000140C, -000146B		
dimensions:	FULL SCALE	MODEL SCALE
TOTAL DATA		
Area (Theo) - Ft <sup>2</sup> Planform Span (Theo) - In. Aspect Ratio Rate of Taper Taper Ratio Sweep-Back Angles, Degrees. Leading Edge Trailing Edge O.25 Element Line  Chords: Root (Theo) WP Tip (Theo) WP	413.253 315.72 1.675 0.507 0.404 45.000 26.25 41.13	0.372 9.472 1.675 0.507 0.404 45.000 26.25 41.13
MAC Fus. Sta. of .25 MAC W.P. of .25 MAC B.L. of .25 MAC	199.81 1463.35 635.52 0.0	5,994 43,901 19,066 0,0
Airfoil Section Leading Wedge Angle - Deg. Trailing Wedge Angle - Deg. Leading Edge Radius	10.0 14.92 2.0	10.0 14.92 0.060
Void Area	13.17	0.0019
Blanketed Area	0.0	0.0

MODEL COMPONENT: WING-W	•	
GENERAL DESCRIPTION: Configuration 4		
NOTE: Identical to Way, except airfoil thickness.	Dihedral angle	is along
trailing edge of wing.		
MODEL SCALE: 0.030		
TEST NO.	DWG. NO. VL7	0-000140A -003200
DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA  Area (Theo.) Ft2  Planform Span (Theo in. Aspect Ratio Rate of Taper Taper Ratio Dihedral Angle, degrees Incidence Angle, degrees Aerodynamic Twist, degrees Sweep Back Angles, degrees Leauing Edge Trailing Edge 0.25 Element Line Chords: Root (Theo) B.P.0.0. Tip. (Theo) B.P. MAC Fus. Sta. of .25 MAC W.P. of .25 MAC EXPOSED DATA  Area (Theo) Ft2 Span, (Theo) In. BP108 Aspect Ratio Taper Ratio Chords Root BP108 Tip 1.00 b  MAC Fus. Sta. of .25 MAC W.P. of .25 MAC B.L. of .25 MAC B.L. of .25 MAC	2690.00 936.68 2.265 1.177 0.200 3.500 0.500 -10.056 35.209 -689.24 137.85 474.81 1136.83 290.58 182.13 1751.50 720.68 2.059 0.245 -562.09 137.85 392.83 1185.98 295.30 251.77	2.421 28.10 2.265 1.177 0.200 3.500 0.500  45.000 -10.056 35.209  20.677 4.136 14.244 34.105 8.717 -5.464  1.576 21.620 2.059 0.245 16.863 4.136 11.785 35.579 8.829 7.555
Airfoil Section (Rockwell Mod NASA)  XXXX-64  Root b =	0.113	0.113
Tip <u>b</u> =	0.120	0.120
Data for (1) of (2) Sides  Leading Edge Cuff Planform Area Ft2 Leading Edge Intersects Fus M. L. @ Sta Leading Edge Intersects Wing @ Sta	113.18 500.0 1025.0	0.102 15.0 30.720

TABLE IV.

FUSELAGE PRESSURE TAP LOCATIONS -

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TER-	hook	205	7.35	795	388	9.75	11.40	13.20	13.50	1395	15.00	16.80	R75	2175	24.46	29.40	22.40	7.40 .729 137
ORBITER- IN.	Full Mod	235	245	265	295	325	330	28	150		580	560 1/6.80	625	725	880	88	88	1885

TABLE IV. - Concluded.

FUSGLAGE PRESSURE TAP LOCATIONS

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				.965	229	24/	-919	250	267	.953	282	295	950	310	323
				æ6.	228	320 241	839 .879 -919	253	26 266 267	305	182	294	900	309	322 323
\s				.865	227	239		252		183	280	293	.950	308	128
TAP LOCATIONS				<i>B</i> 20	226	2.38	.798	251	244	565 .760 .808 .657	279	290 291 292 293 294	026.400.550.725.026.035.	202	315 316 37 318 319 320 321
1007				.700	225	237	769.	250	263	.760	278	762	325	306 306 406	3/9
TAP	.793	2/6	j							.565	277	330	550	305	318
	127	215	1	187	224	236	.390	229	282	402	276	588	400	324	11/2
//SS3	547 .633 727	2/4	١	:362	223	233	.246	345	18	274	275	388 289	320	30.5	3/6
186	_	2/3	1	627.	22	13.34	.086.163	247	260	.777	274			302	315
WING PRESSURE	429	2/2	1	<b>35</b> 0.	22.1	233	.086	246	52	.020 .040 .083 . 177	273	183 384 285 286 387	051.080		P/E
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TABLE V. - Concluded.

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TABLE VI.

ORBITER WELTICAL TAIL & SPEED BRAKE PRESSURE TAF LOCATIONS

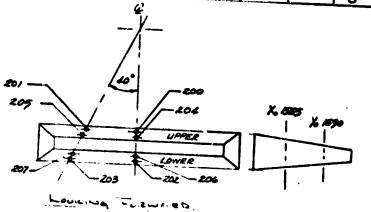
7	VERTICEL (LHOMY)				•	4/2/2	٠.						
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1	SHEED DRONKE	7 6.11	Scale	600		630		000	630	720	74.0	750

TABLE VII.

# BOOVELAD PAISSURE TAP LOCATIONS

ORBIT	El-X.		0-1	PAGREES	}	
	MODEL Scale	12.	0	10	16. 1493	₹No
	46.65		200	201		TAPS
15552	44.65		202	203		2
1590 1	47.70	:046		7	_2_	1
		1.046		205	2	6
***************************************		7.040	206	207	2	R



Notes:

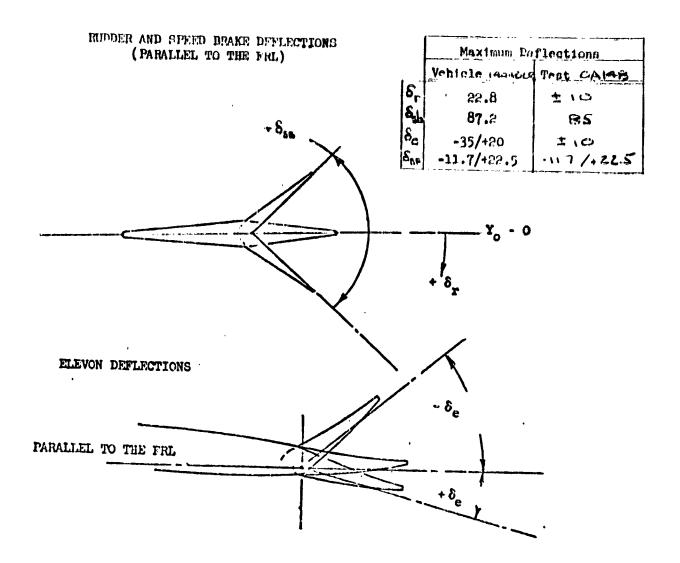
Positive directions of force coefficients, moment coefficients, and angles are indicated by arrows

axes have been displaced from the center For clarity, origins of wind and stability of gravity 2.

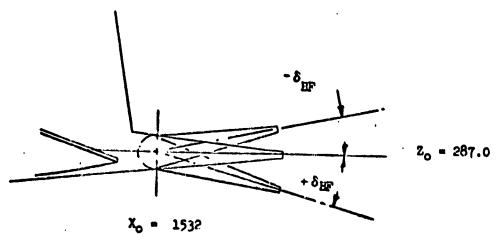
Figure 1. - Axis systems and sign conventions a. Orbiter Axis Systems

50

RIP Condition

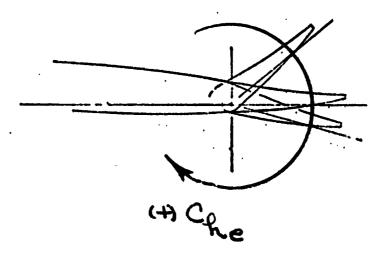


#### BODY FLAP DEFLECTIONS



b. Definition of Angular Measurements

Figure 1. - Continued.



c. Elevon Hinge Moment Sign ConventionFigure 1. - Concluded.

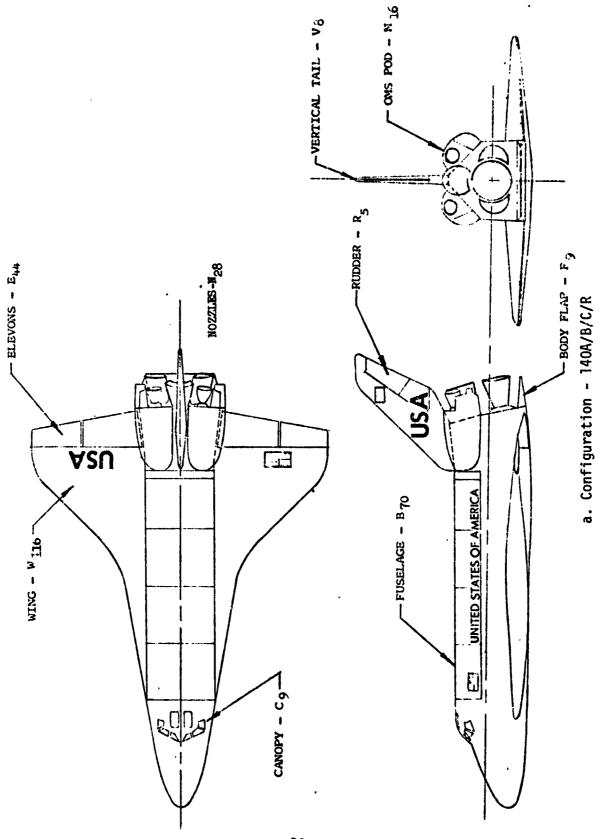
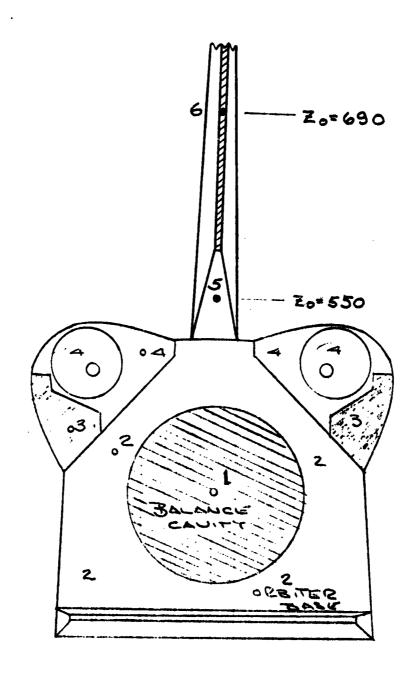
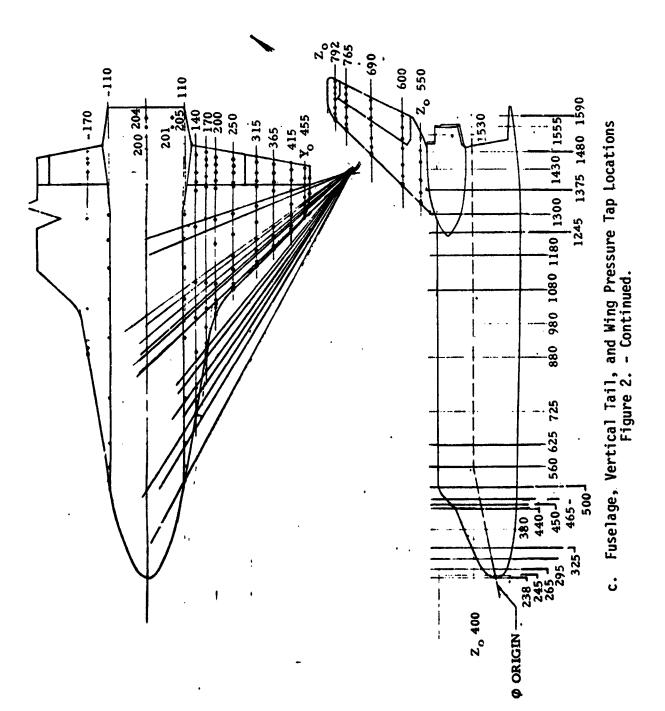


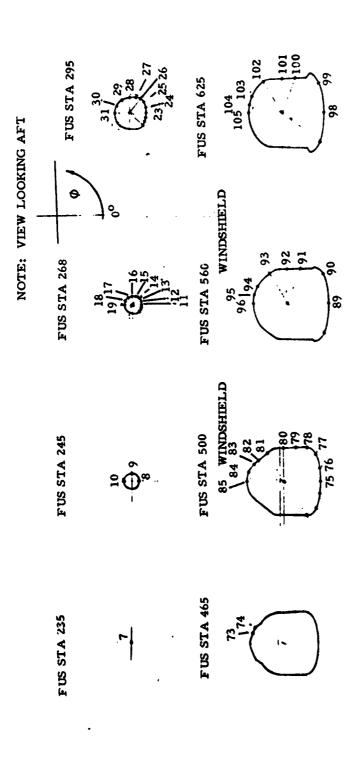
Figure 2. - Model sketches.



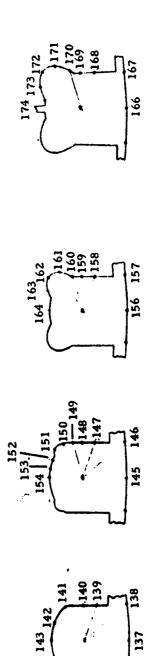
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b. Base Pressure Taps and AreasFigure 2. - Continued.





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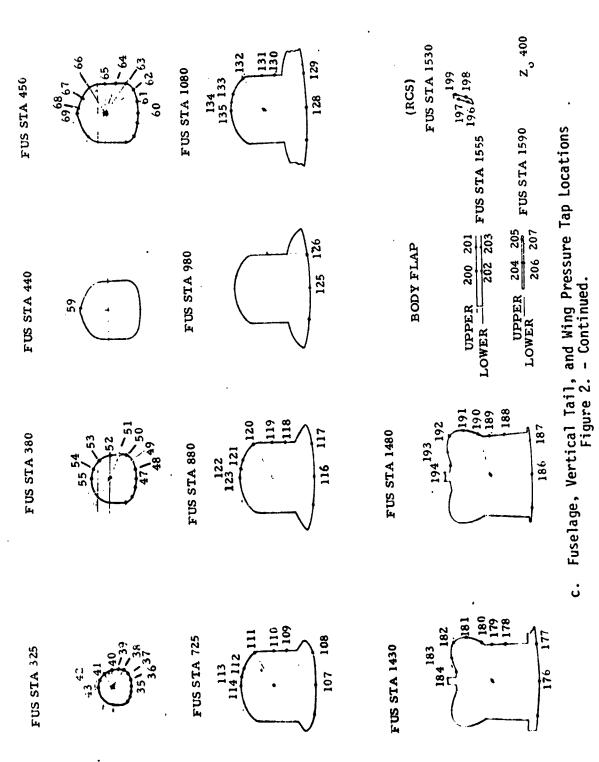
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c. Fuselage, Vertical Tail, and Wing Pressure Tap Locations Figure 2. - Continued.

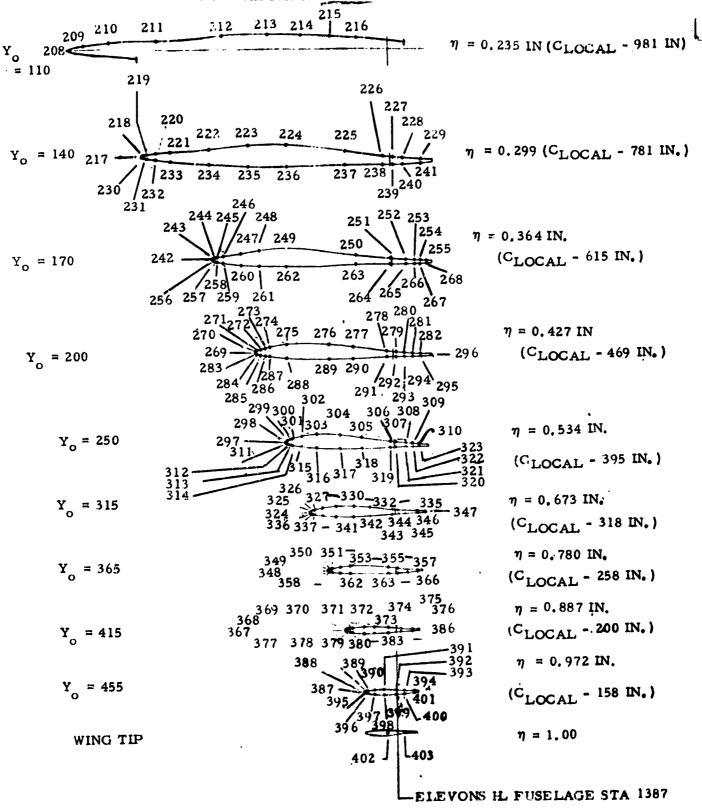
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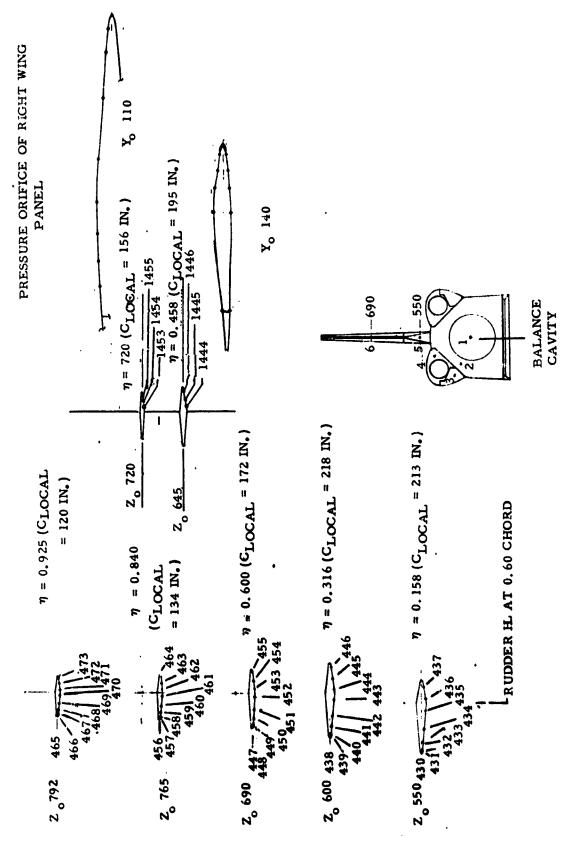
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#### PATSSURE ORIFICE LOCATION OF LEFT WING PANEL



c. Fuselage, Vertical Tail, and Wing Pressure Tap Locations Figure 2. - Continued.

[ ]



Fuselage, Vertical Tail, and Wing Pressure Tap Locations

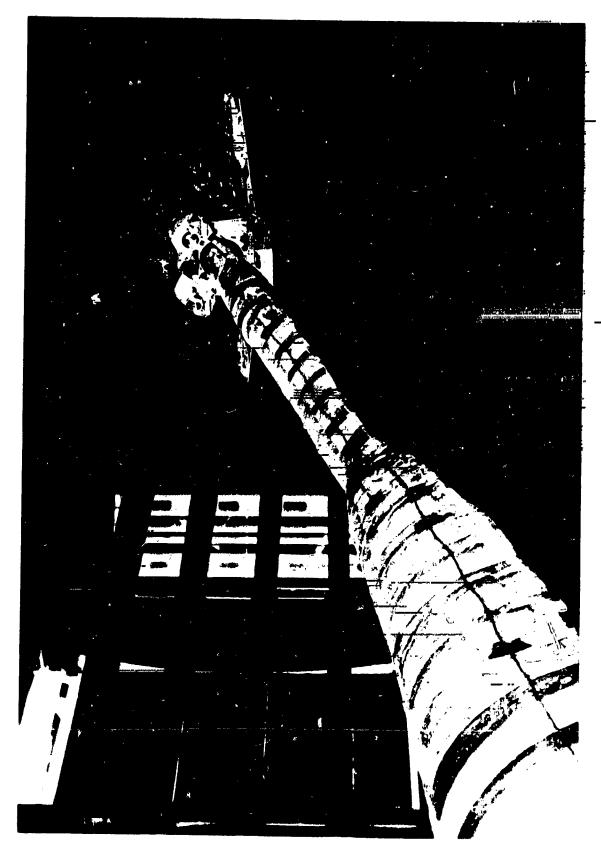
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Figure 2. - Concluded.

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a. Three Quarter Front View of model 47-0 in the ARC 11 x 11 UPWT

Figure 3. - Model installation photographs.



b. Three fuarter Rear View of Model 47-0 in the ARC 11 x 11 UPWT

Figure 3. - Concluded.

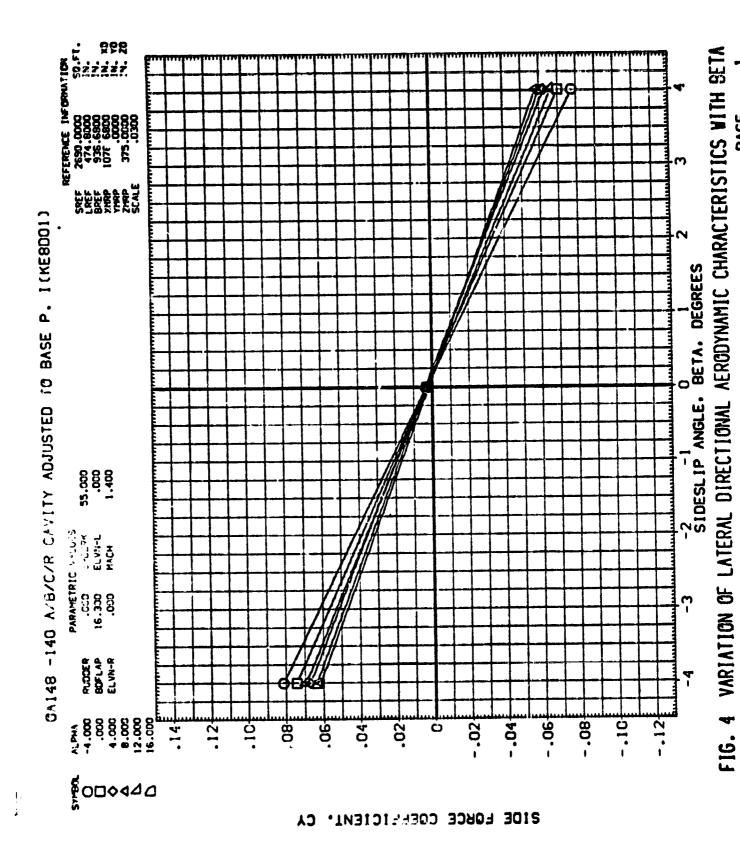
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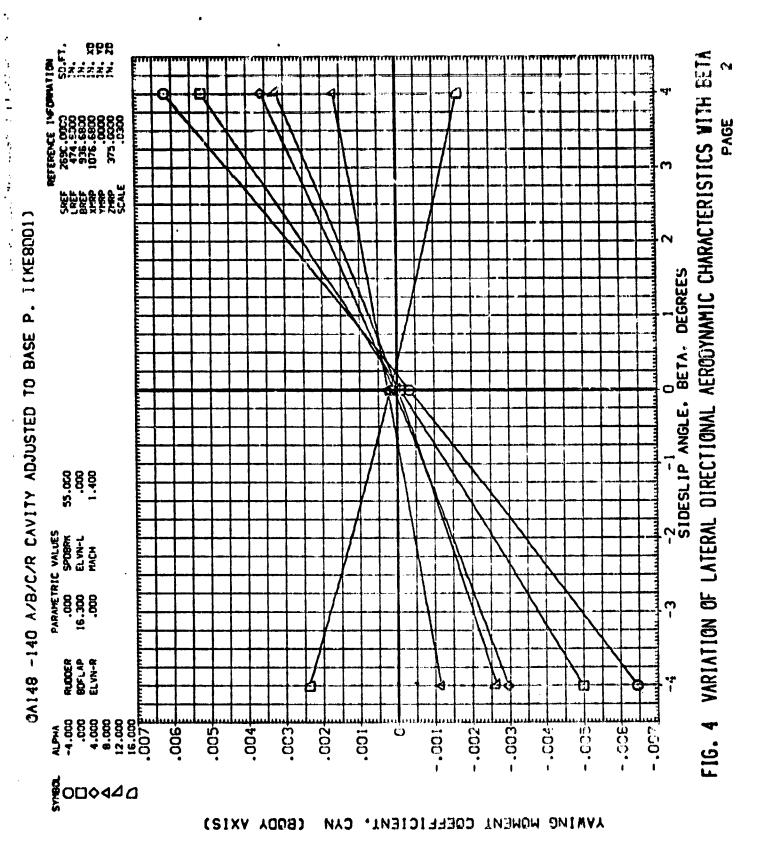
#### DATA FIGURES

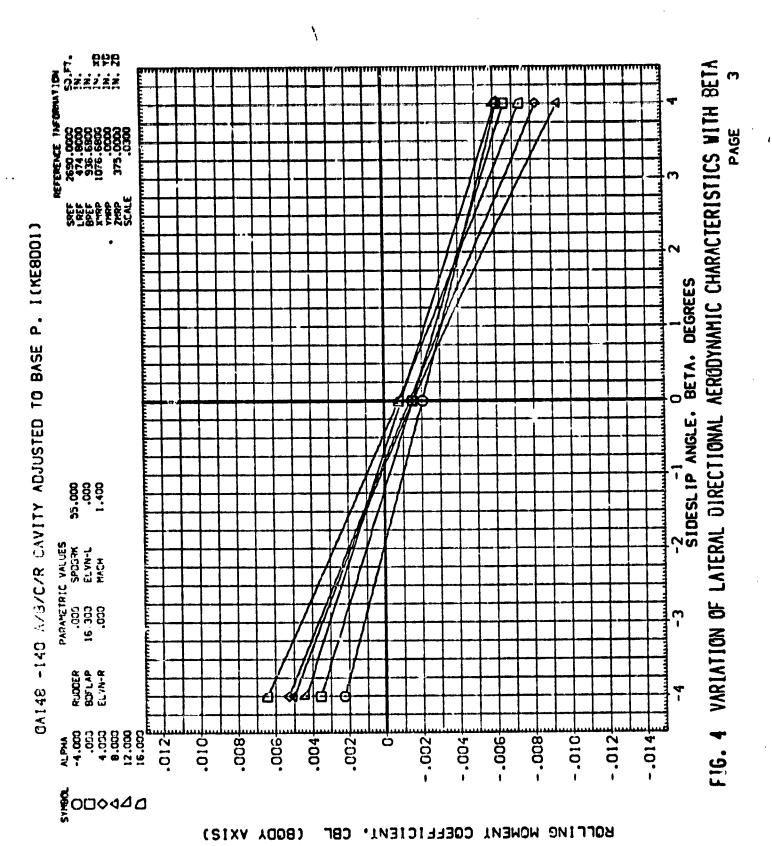
Volume 1 Plotted force data

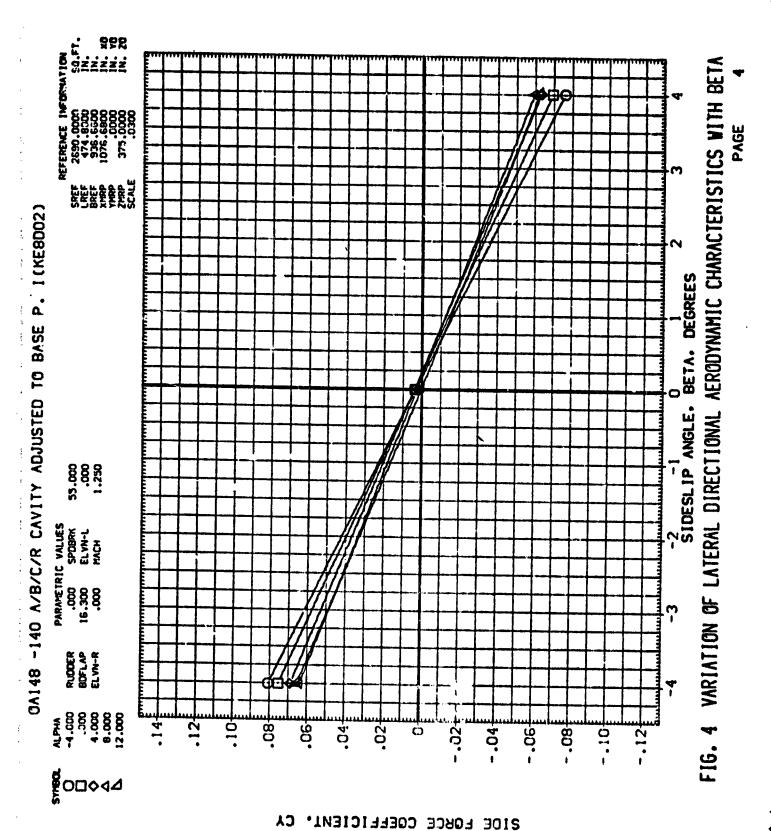
Volume 2 Plotted pressure data

Tabulations of plotted data are available on request from Data Management Services









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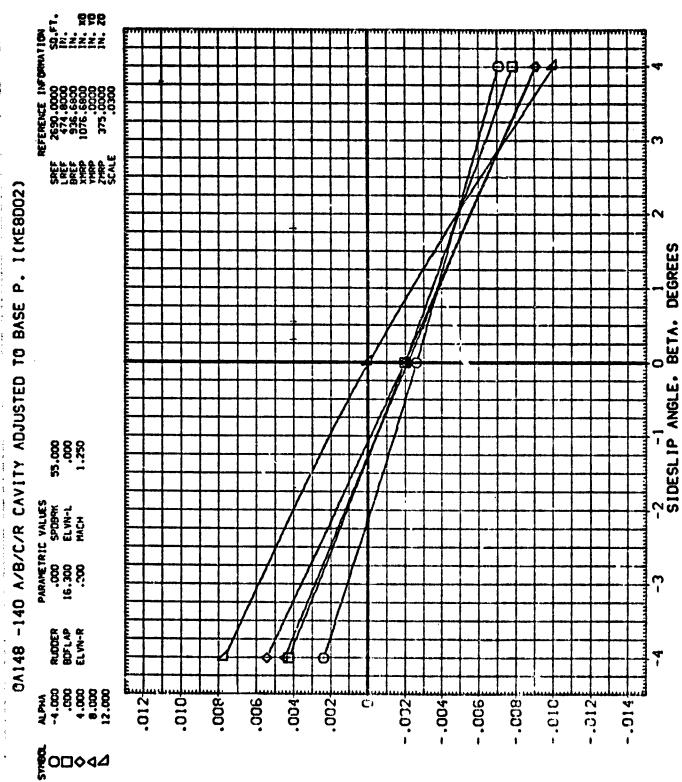
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

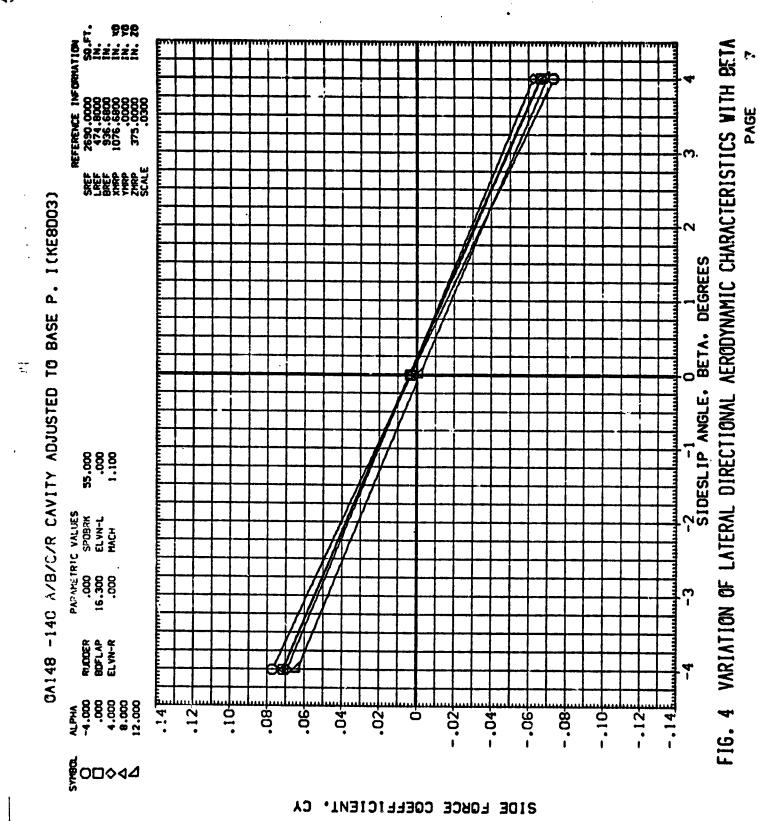
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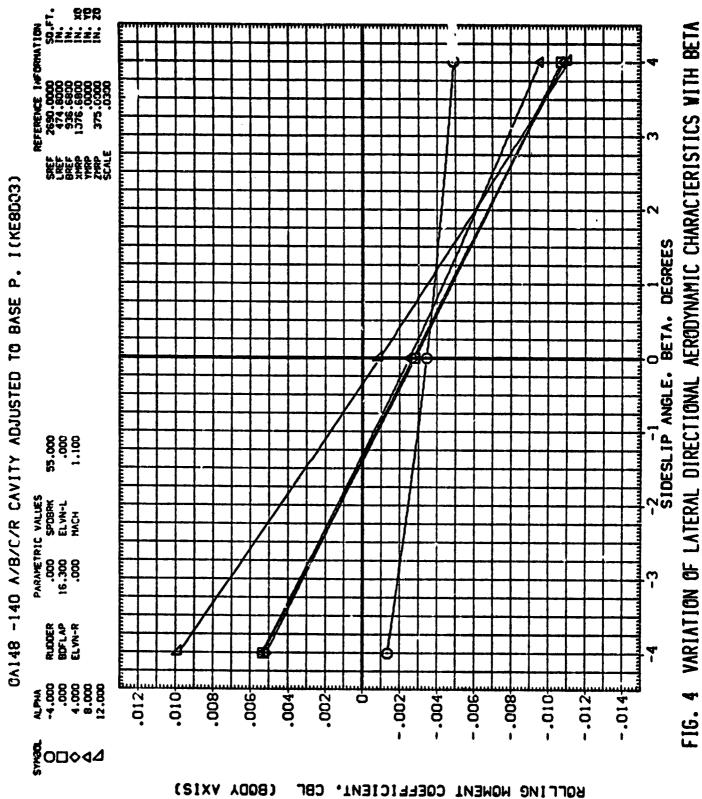
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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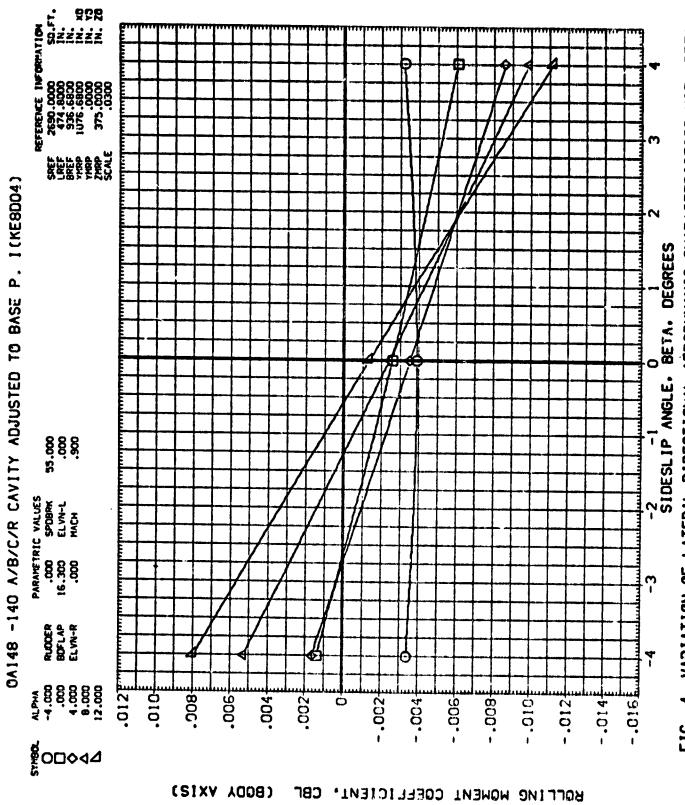
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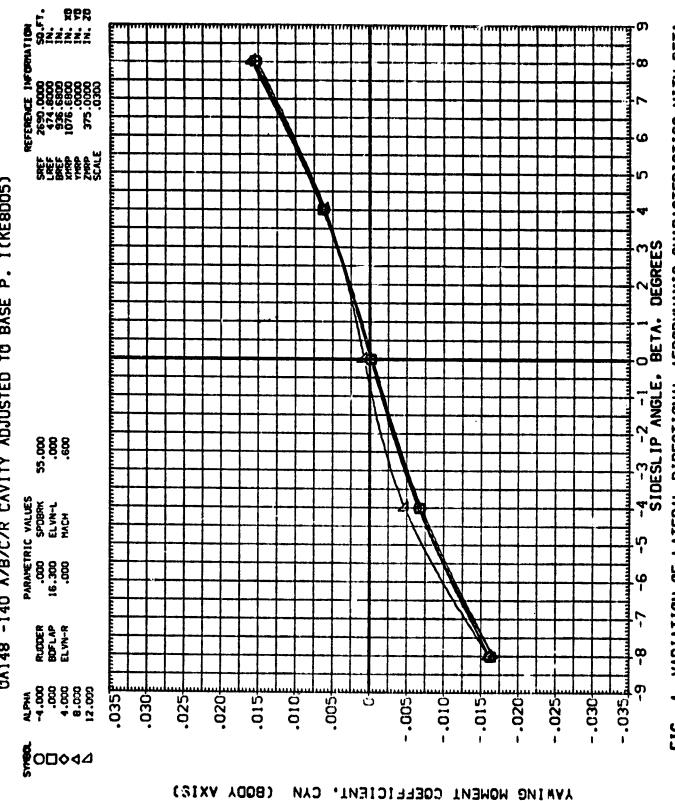
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE

FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE SEEF BREF WHEN WHEN SCALE OA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. ICKEBDOS) -4 -3 -2 -1 0 i 2 3 SIDESLIP ANGLE, BETA, DEGREES 8 8 8 8 8 8 PARAMETRIC VALUES .030 SPUBRY 16.300 ELVN-L -5 9 RUDDER BOFLAP ELVN-R ALPHA -4.000 4.000 9.000 12.000 -030<del>1</del> -.035 -.025 ·010条 -.020 -.030 .025 .015<del>[</del> -.005 -.010 .005 -.015 .020

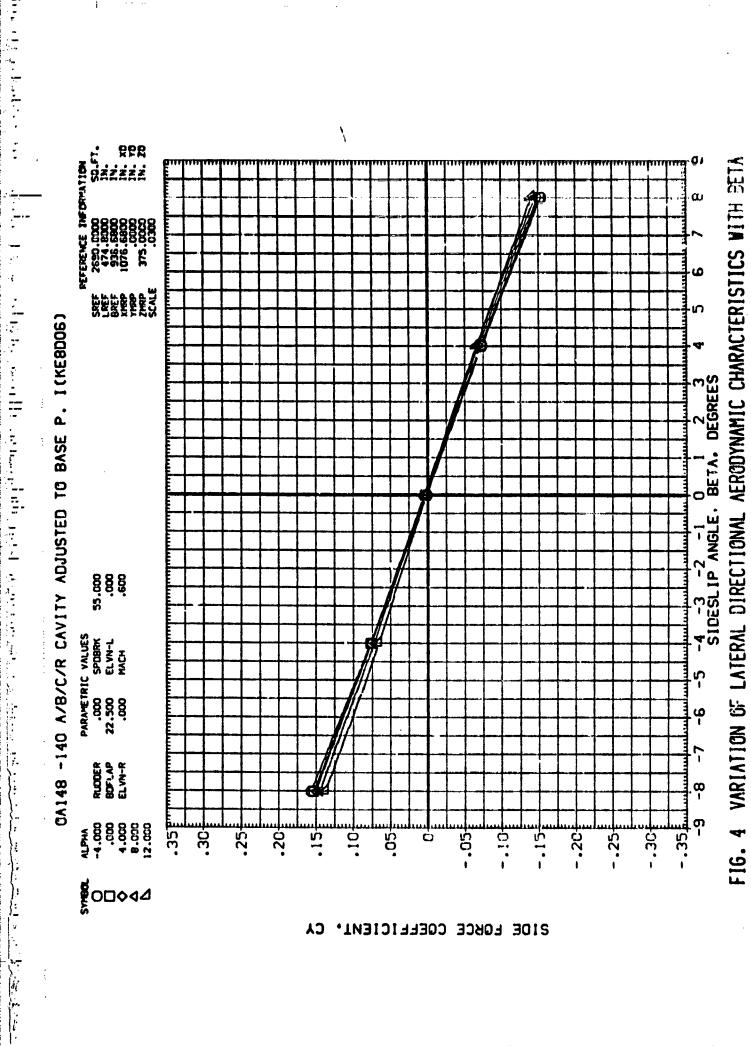
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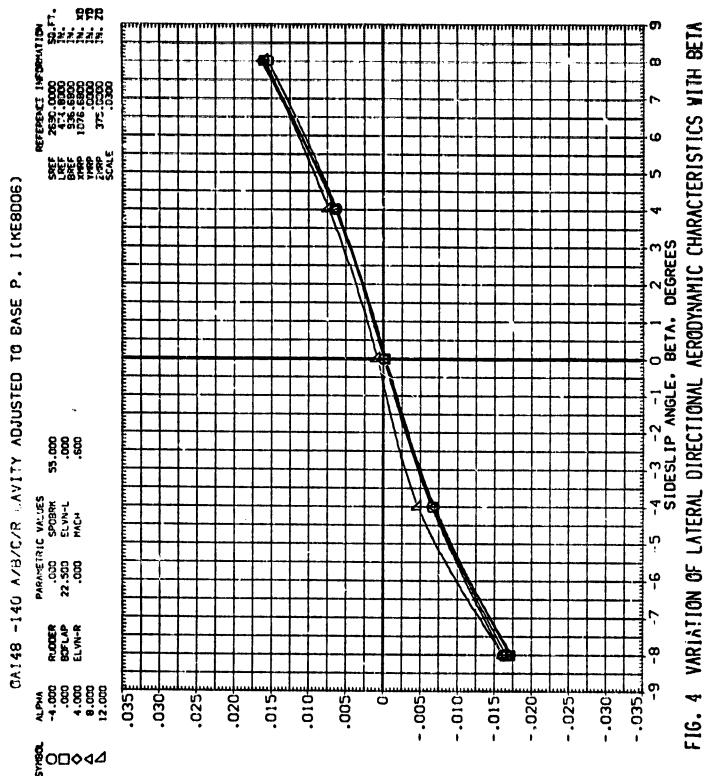
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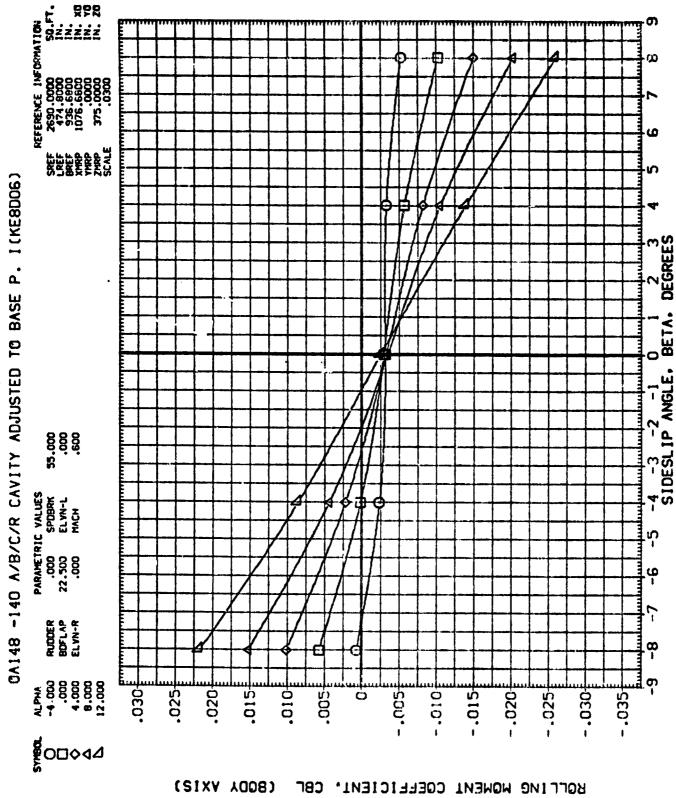


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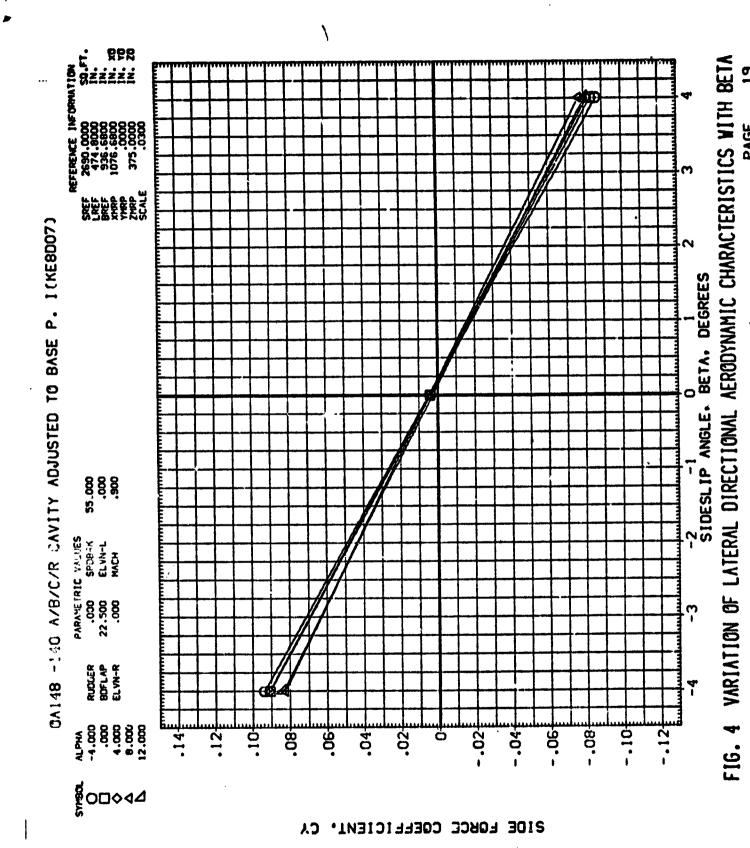
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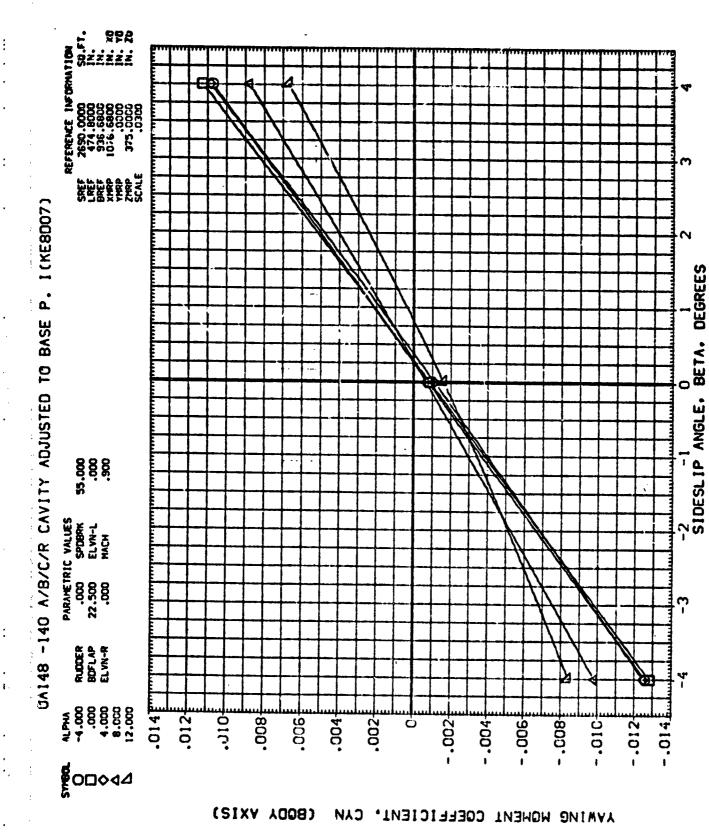
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE





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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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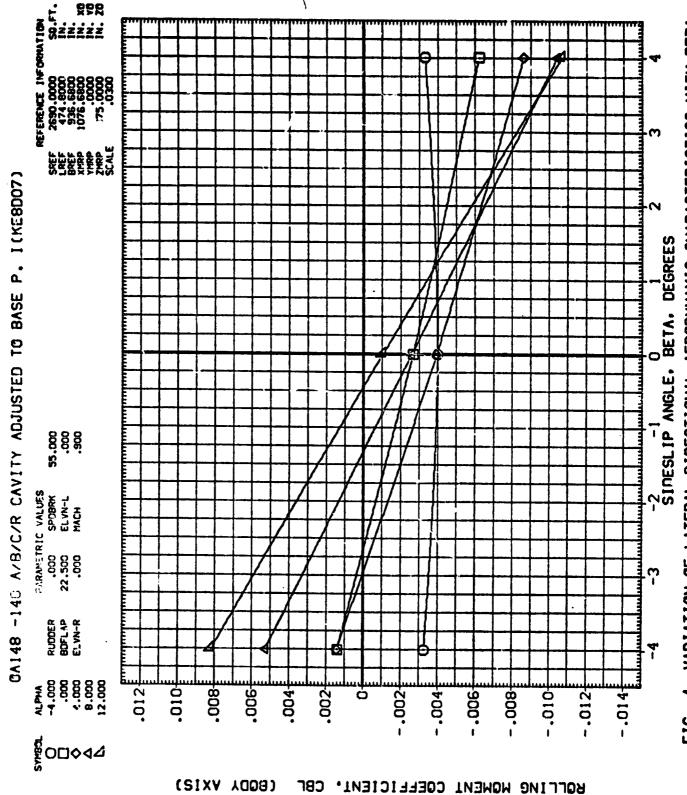
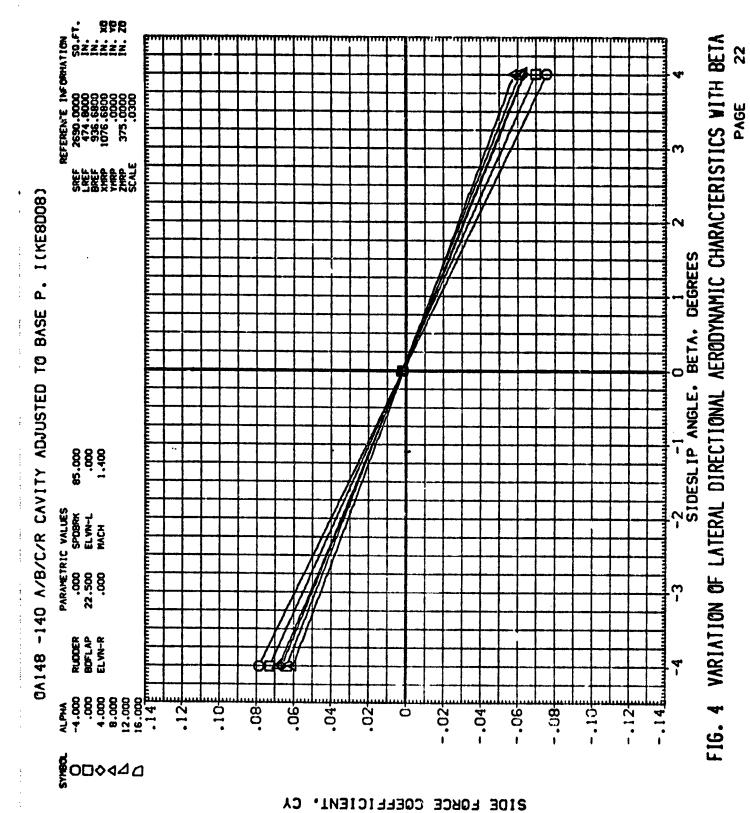


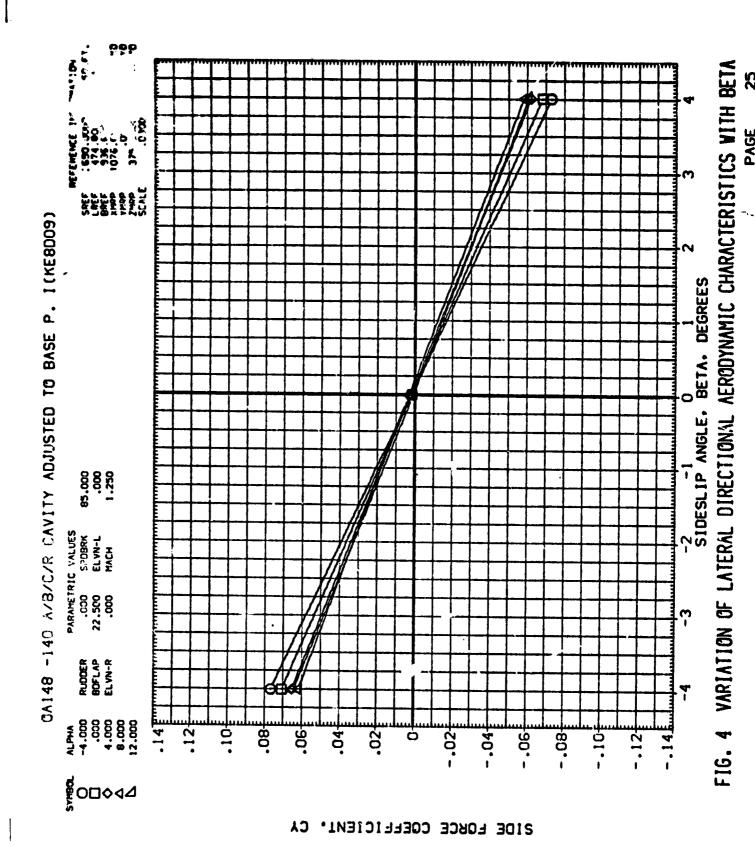
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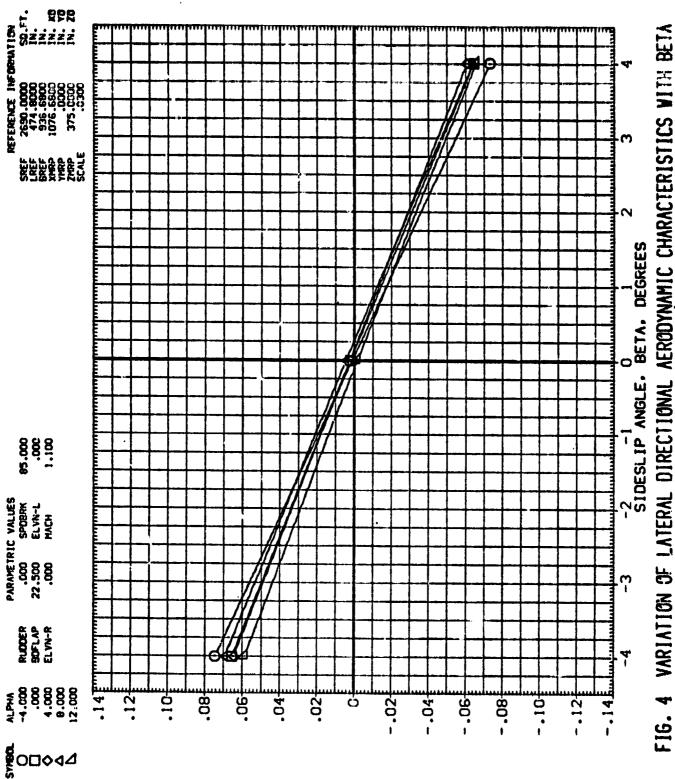
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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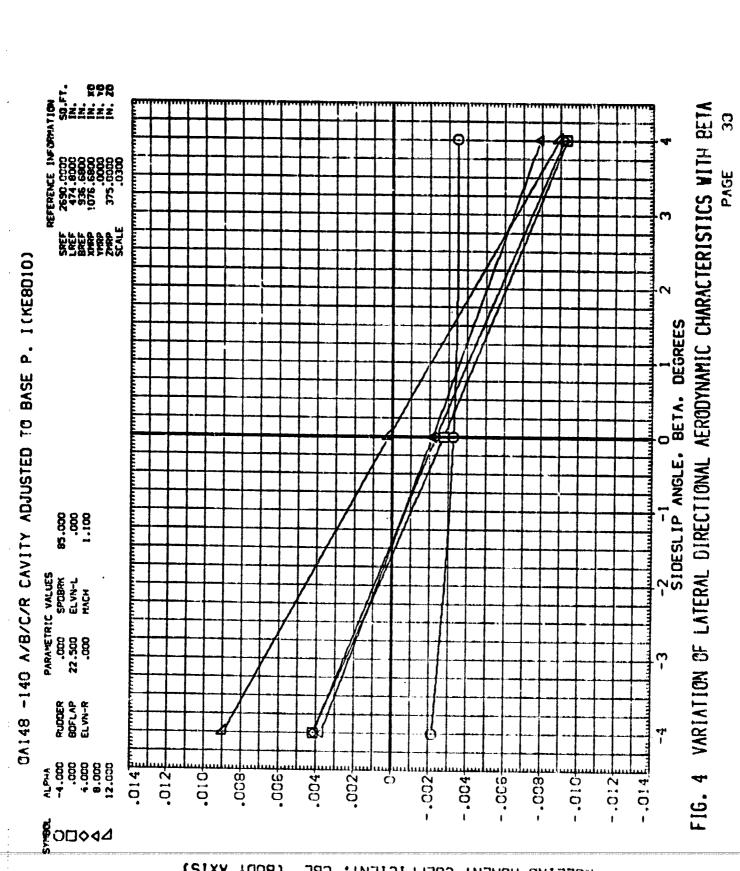
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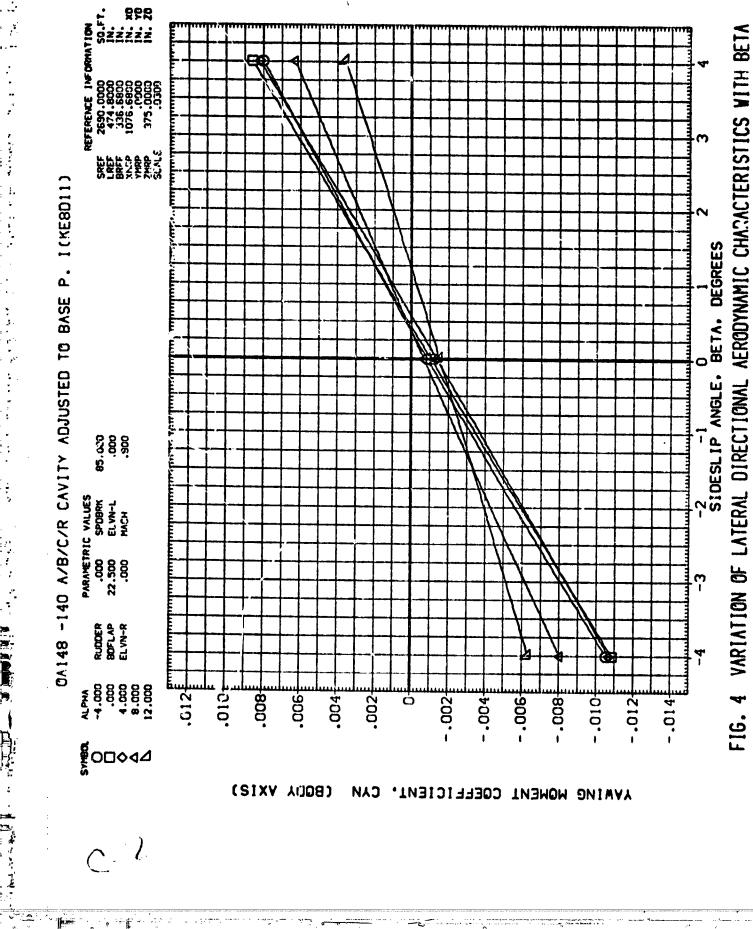
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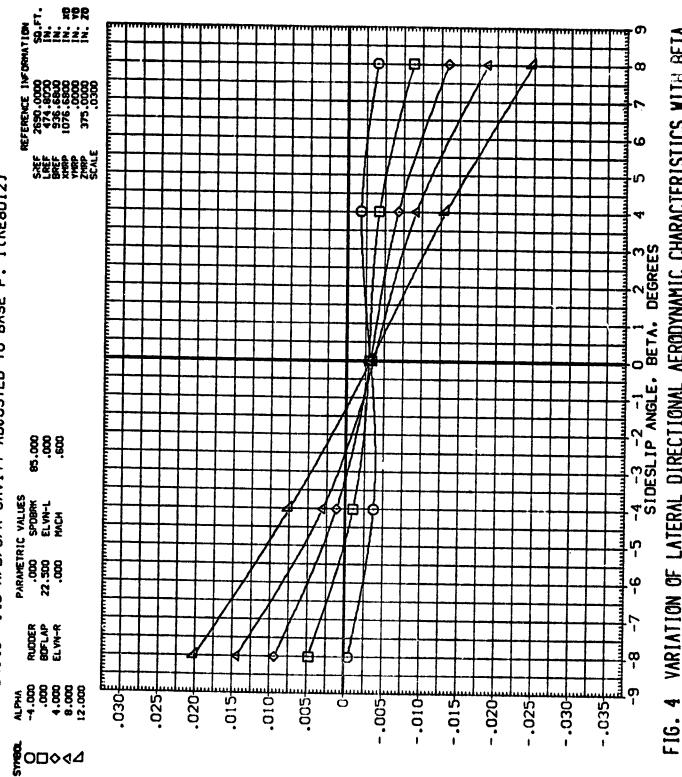
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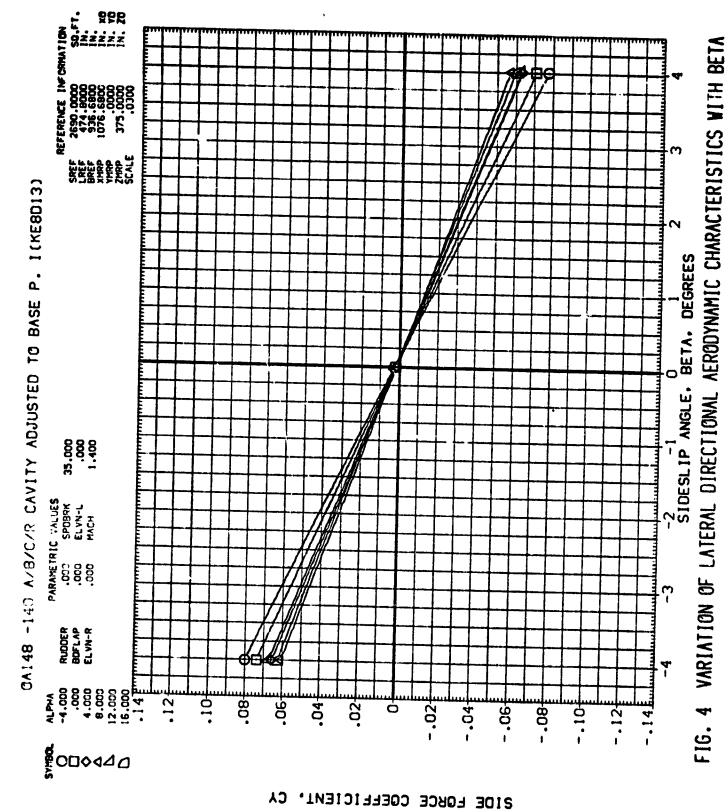
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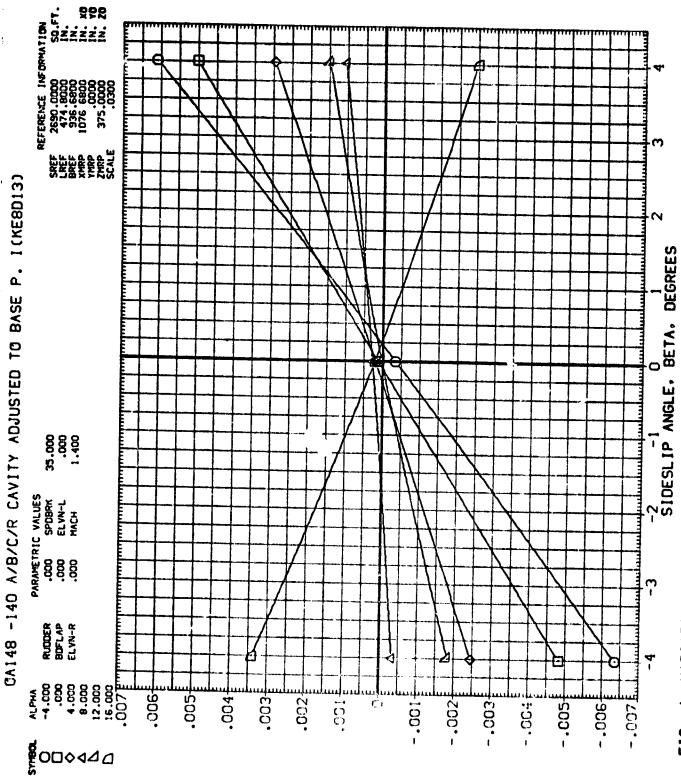
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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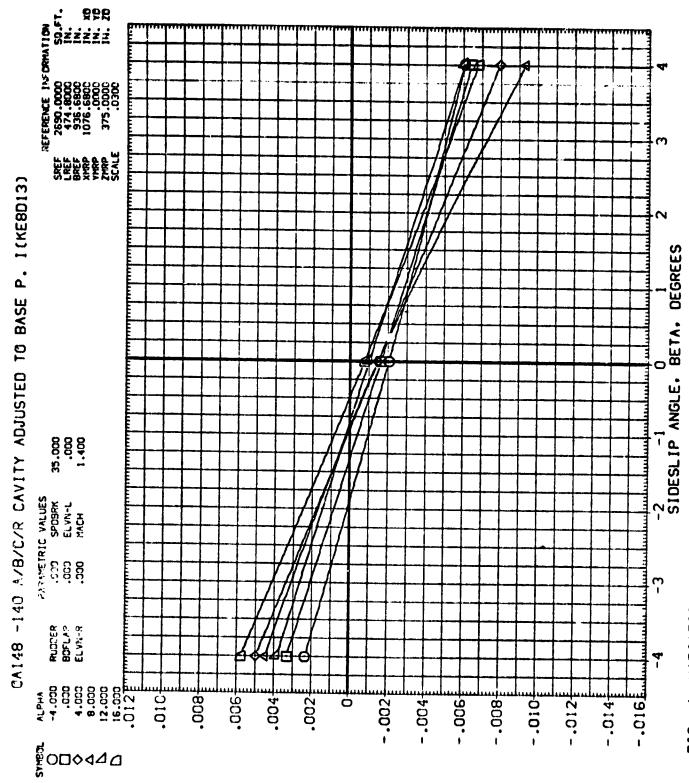
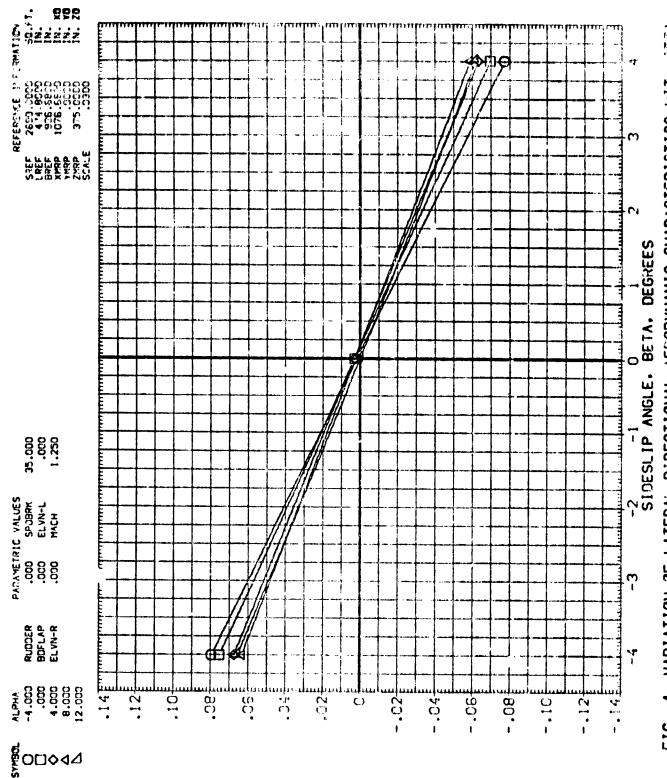
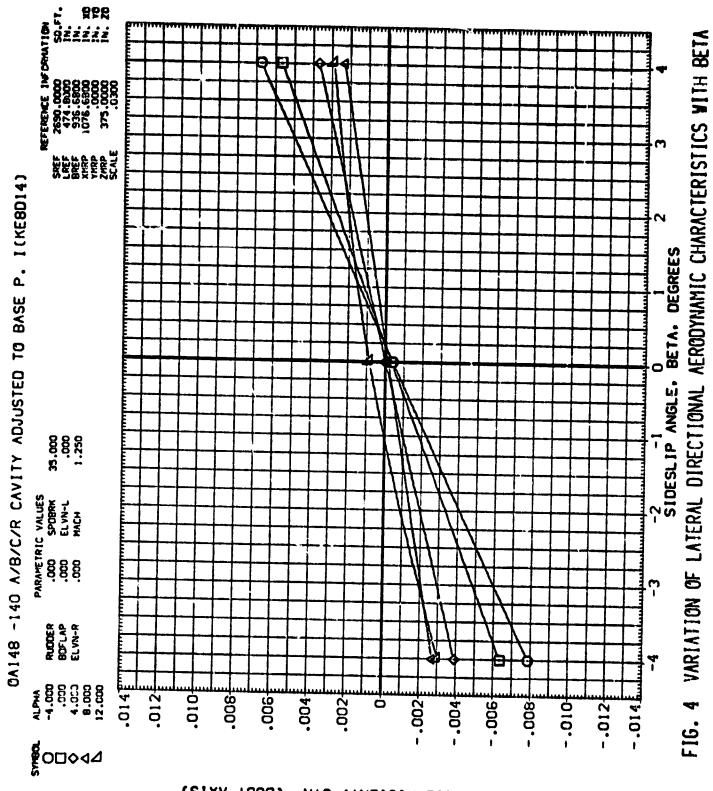


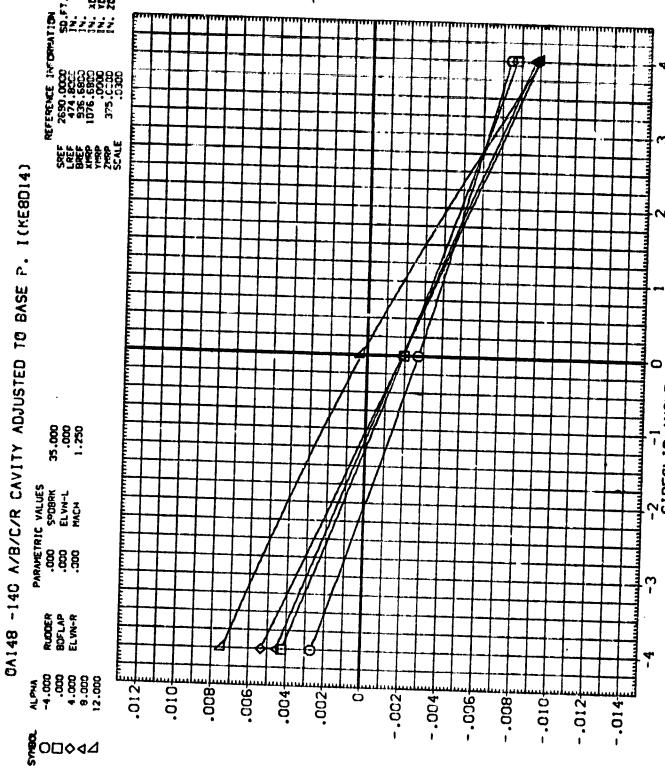
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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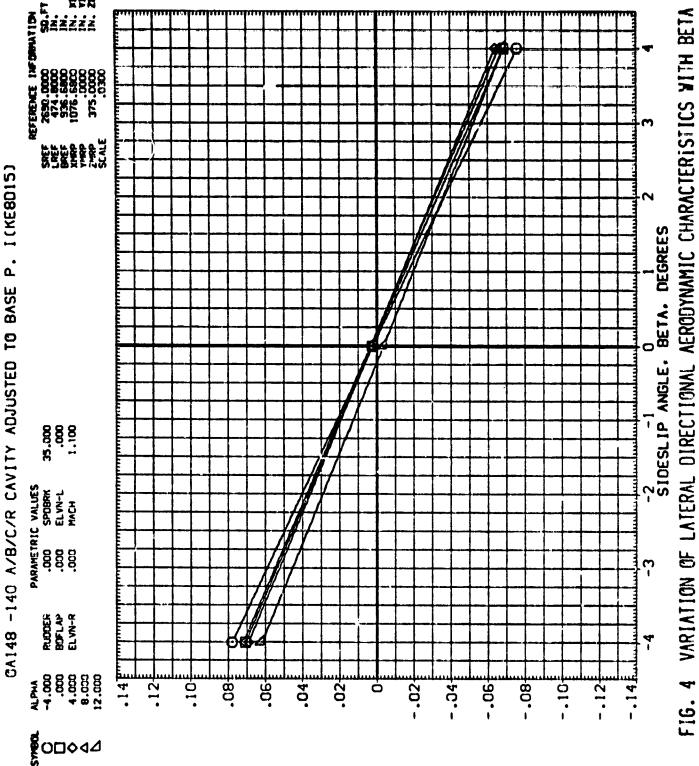
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES

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e eer Gizizi FIG. 4 VARIATION OF LATERAL DIRECTIONAL AFRODYNAMIC CHARACTERISTICS WITH BETA SCALE STATE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I (KEBDIS) -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES 33.000 PARAMETRIC VALUES
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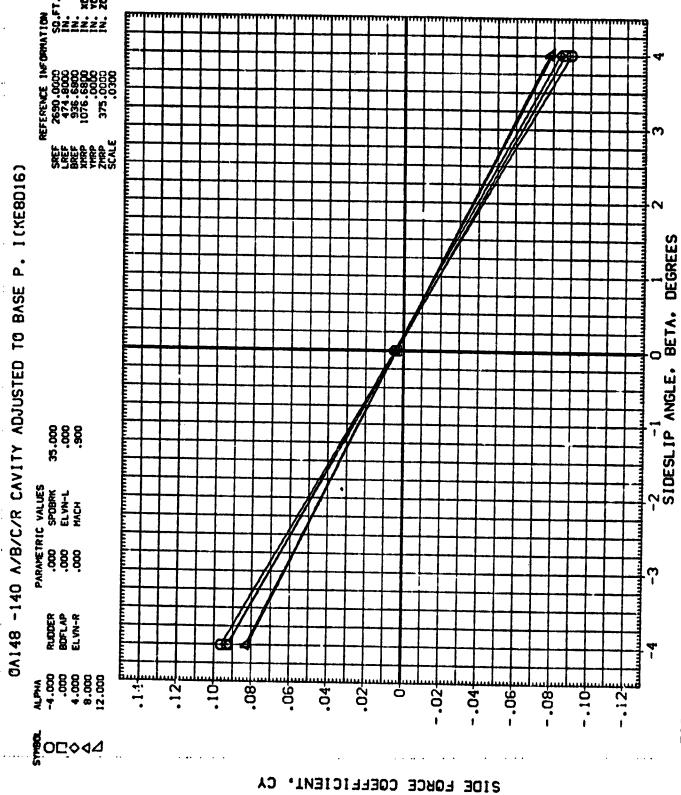
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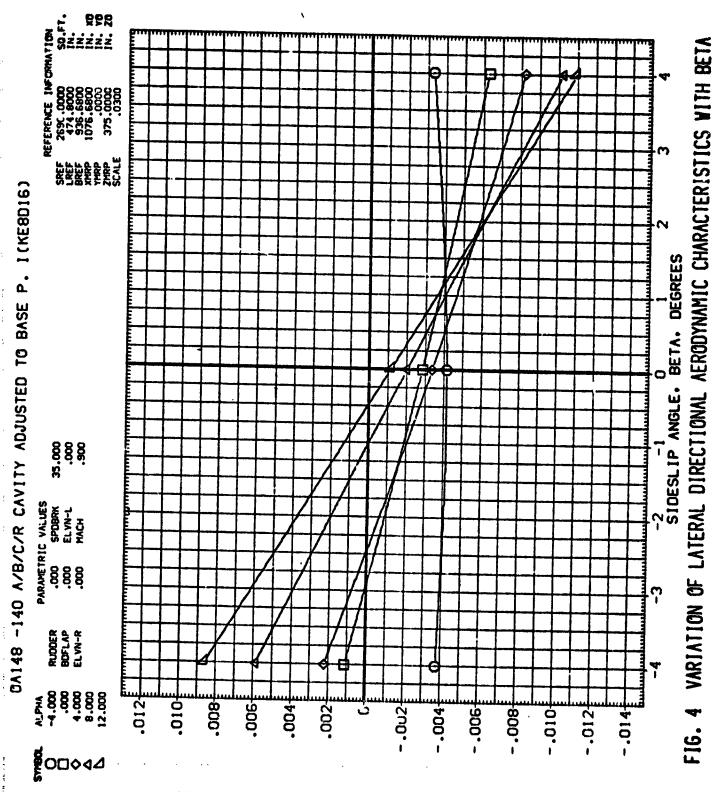
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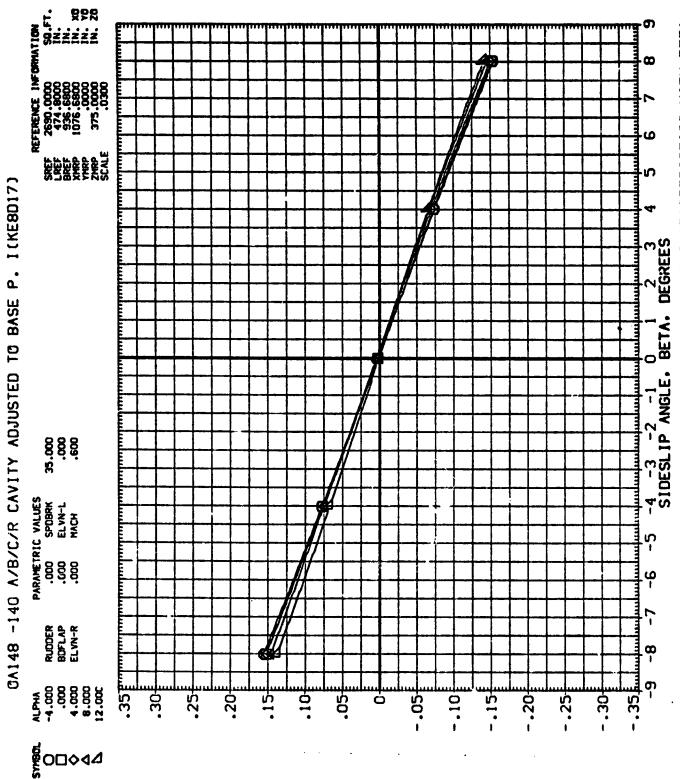
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822222 F 858 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA REFERENCE INF 2859.0000 474.8000 935.6800 1076.6800 375.0000 E SAEF STARP STARP SCALE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I(KE8D17) -4 -3 -2 -1 0 1 2 3 SIDESLIP ANGLE, BETA, DEGREES 86.98. 98.98. 98.98. PARAMETRIC VALUES
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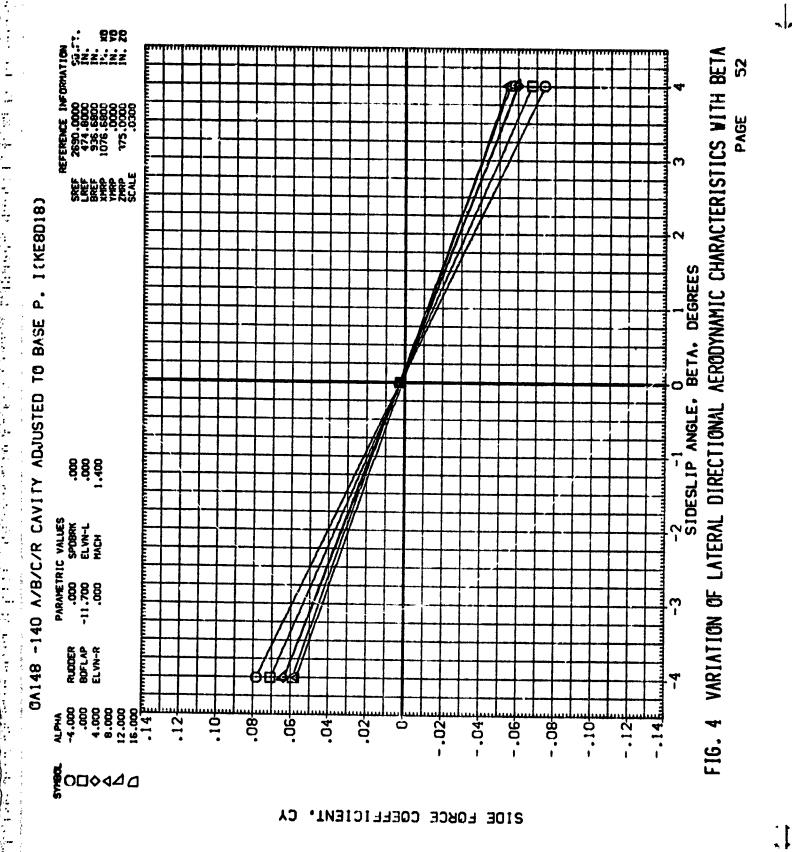
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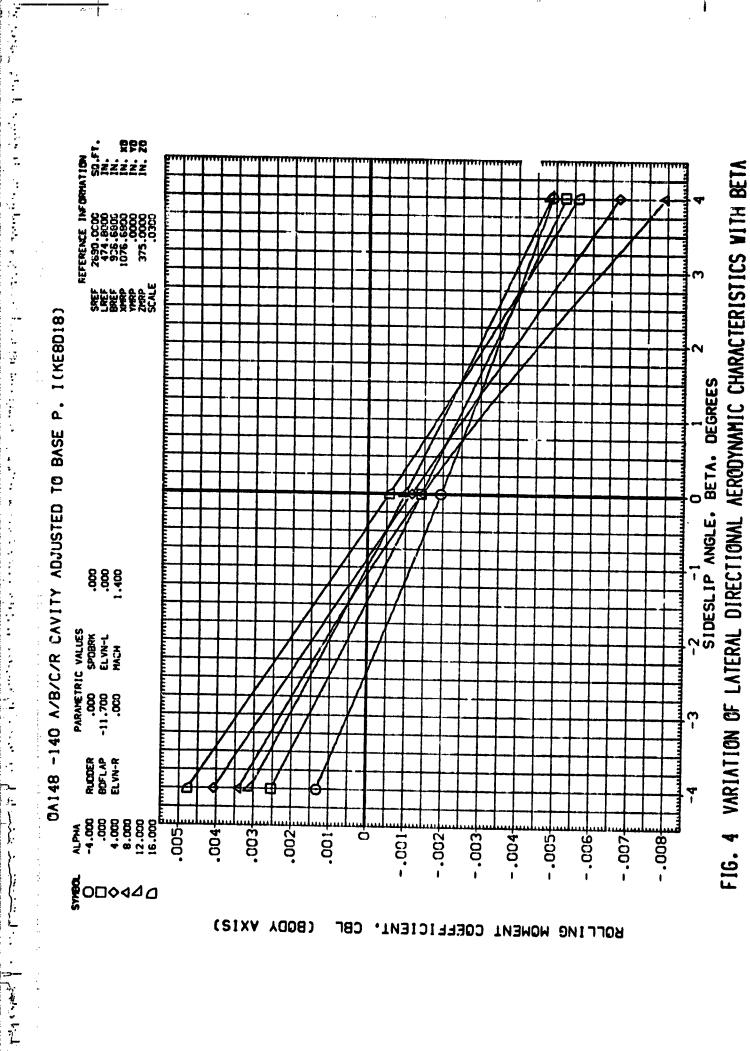
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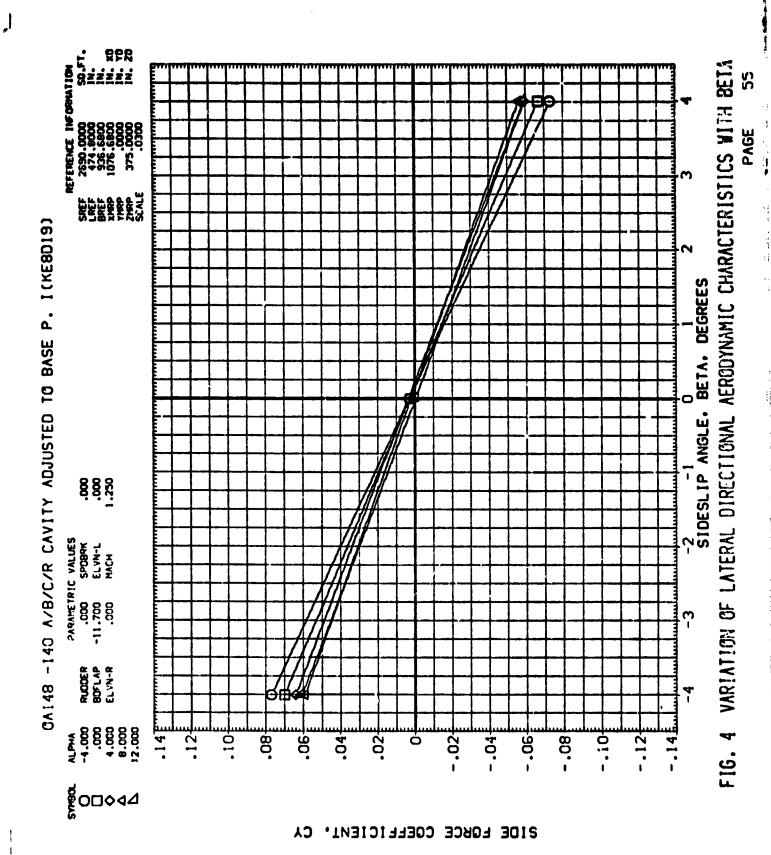
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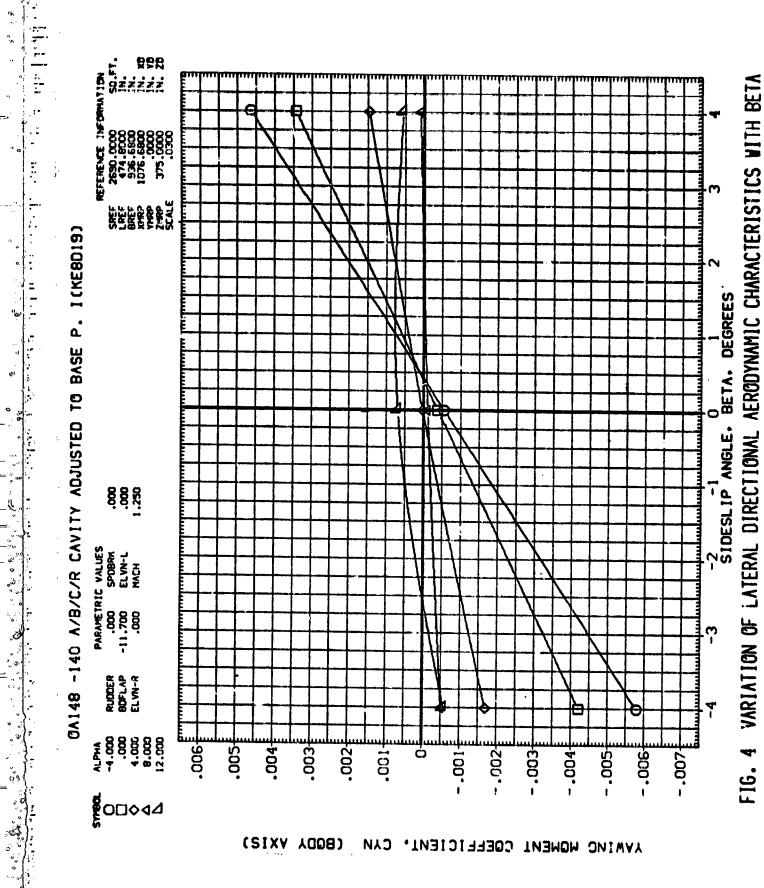
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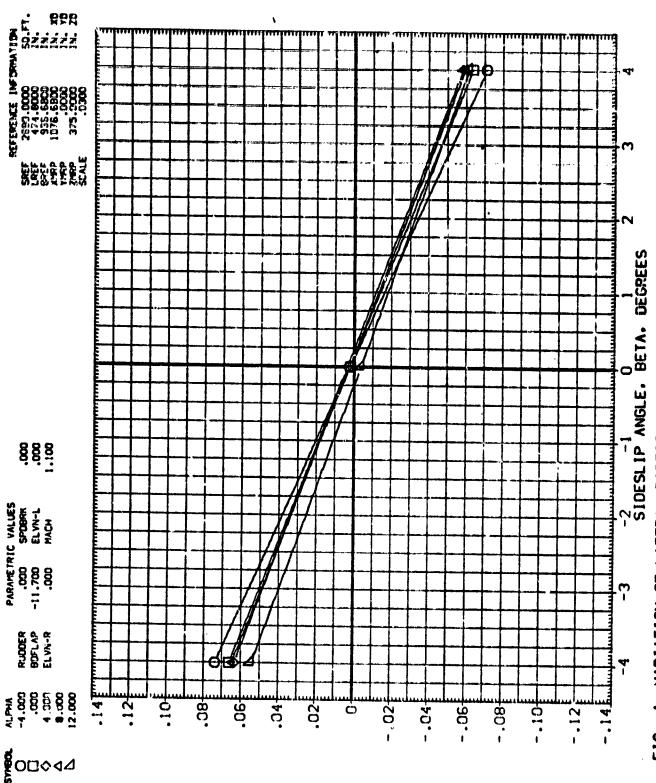
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 57 PAGE

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

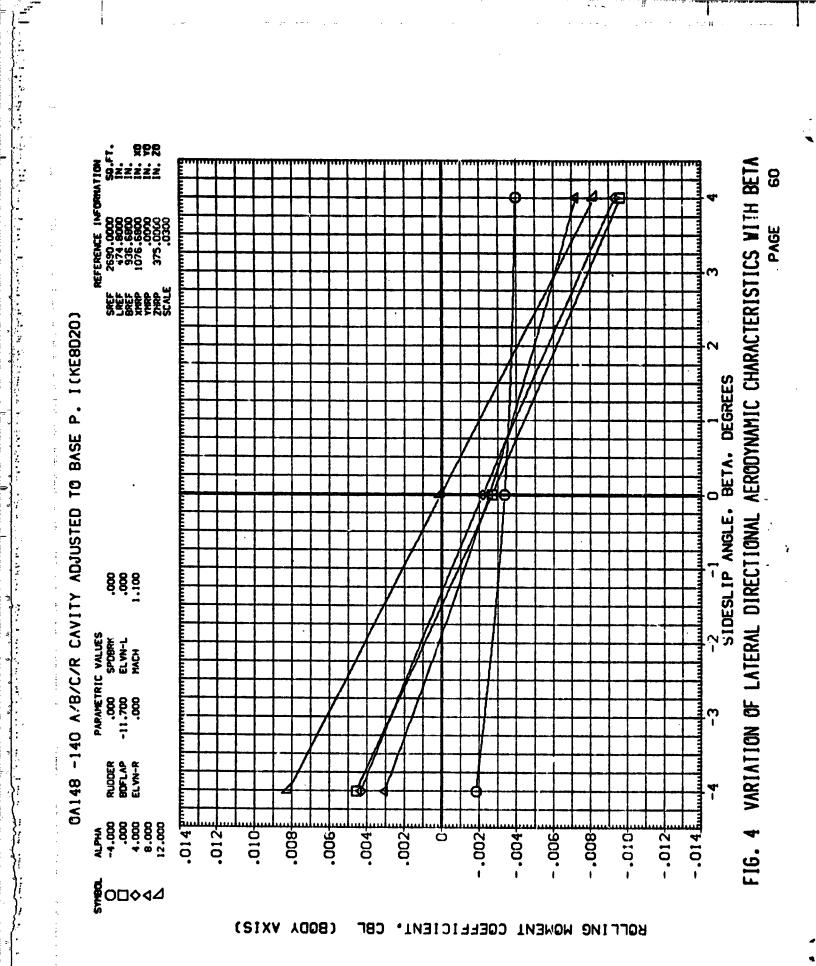
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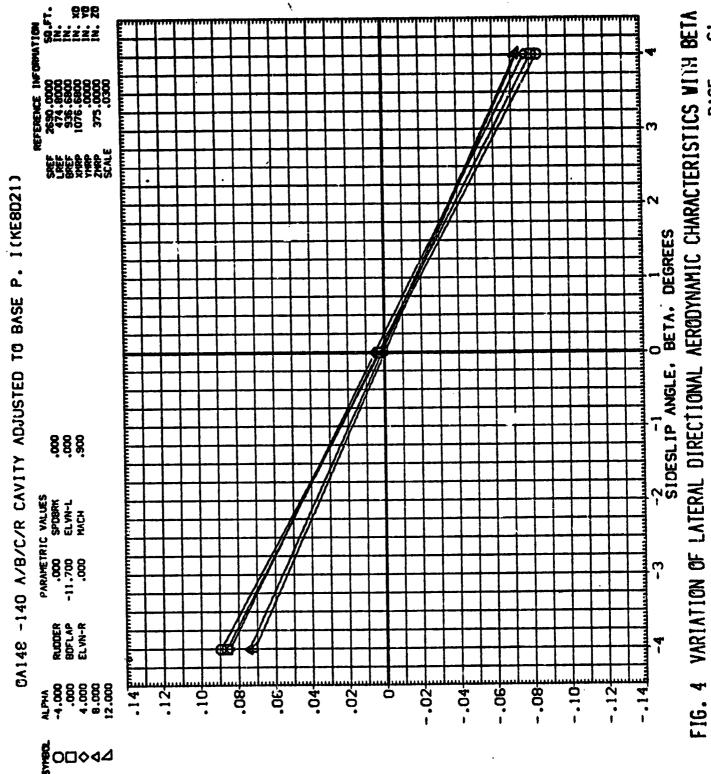
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



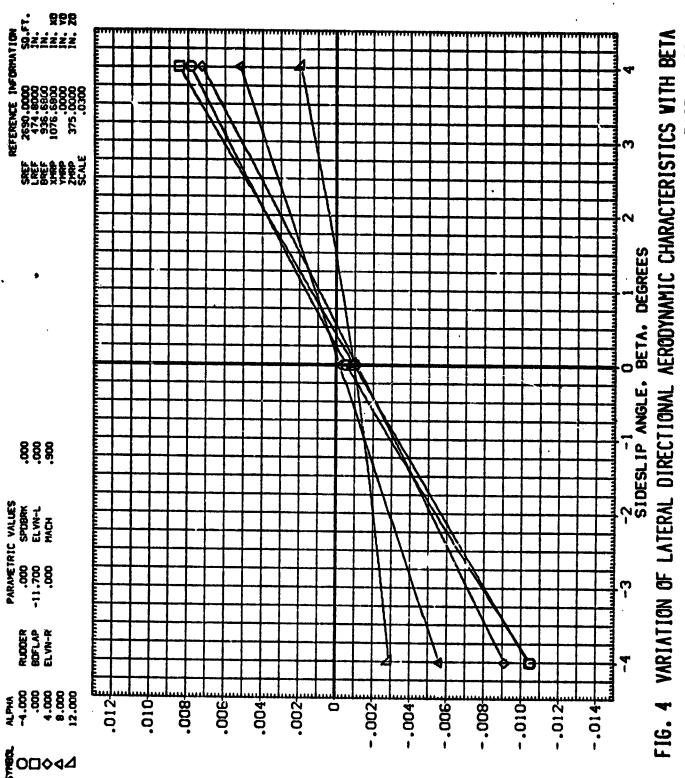
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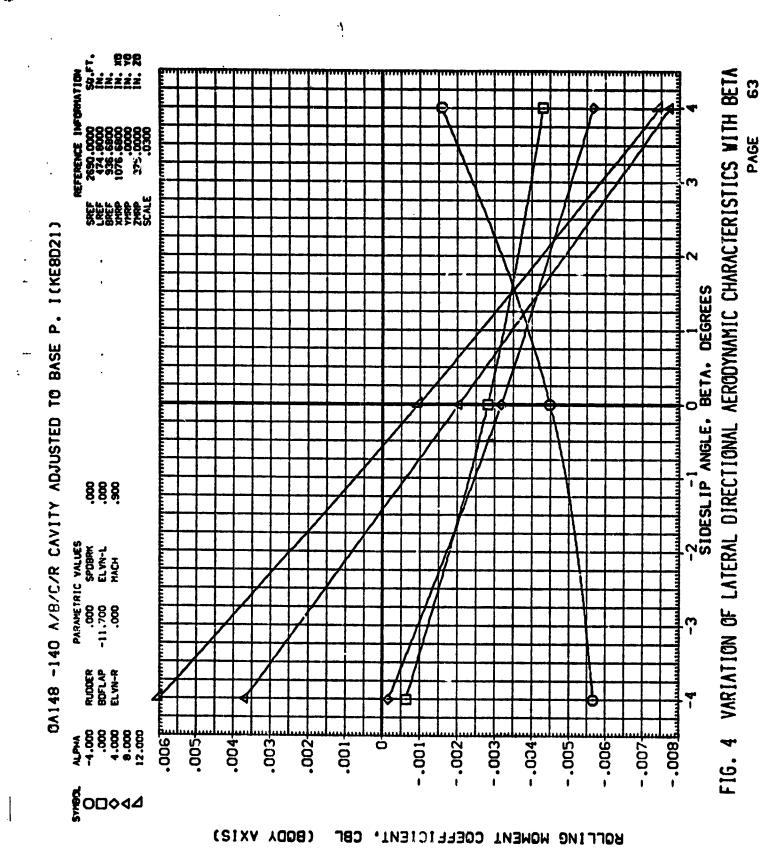
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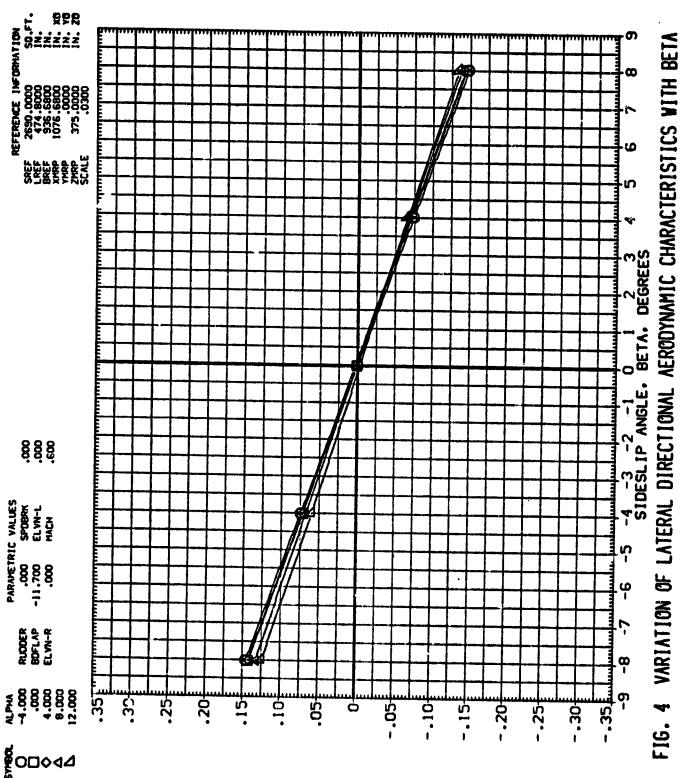
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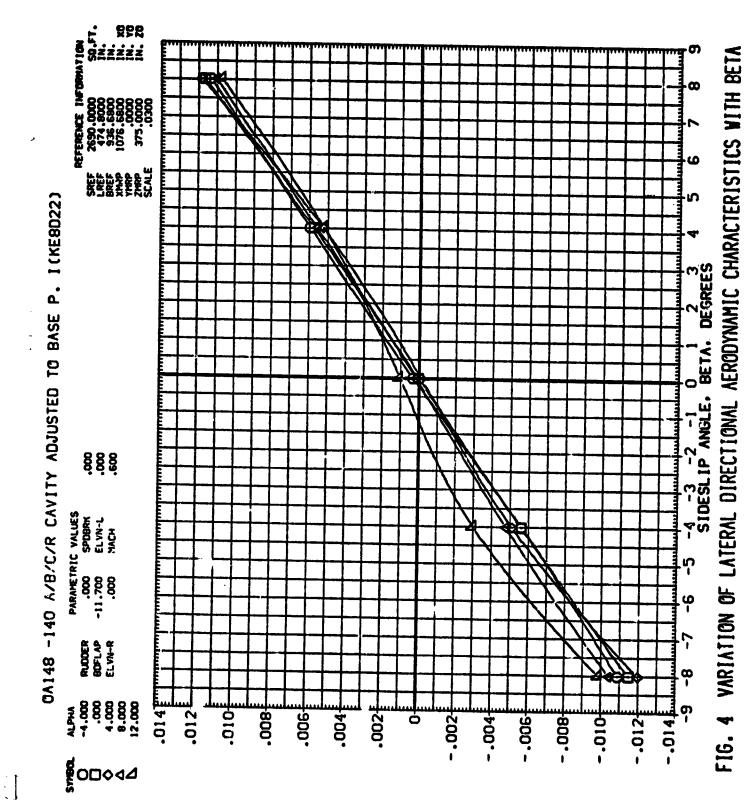
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.0300 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA SREF LREF XHRP XHRP SCALE DA148 -140 A/B/C/R CAVITY ANJUSTED TO BASE P. 1(KE8D22) SIDESLIP ANGLE, BETA, DEGREES 888 PARAMETRIC VALUES .000 SPOBMK -11.700 ELVN-L .000 MACH ņ 9 RUDDER BOFLAP ELVN-R φ ALPAN -4.000 4.000 8.000 12.000 -030£ .025 .020<del>-</del> -015 子10. -c05 6 -.0:0--.005 -.015 -.020 **-.030**₽ -.025 -.035 **€**0□◊44

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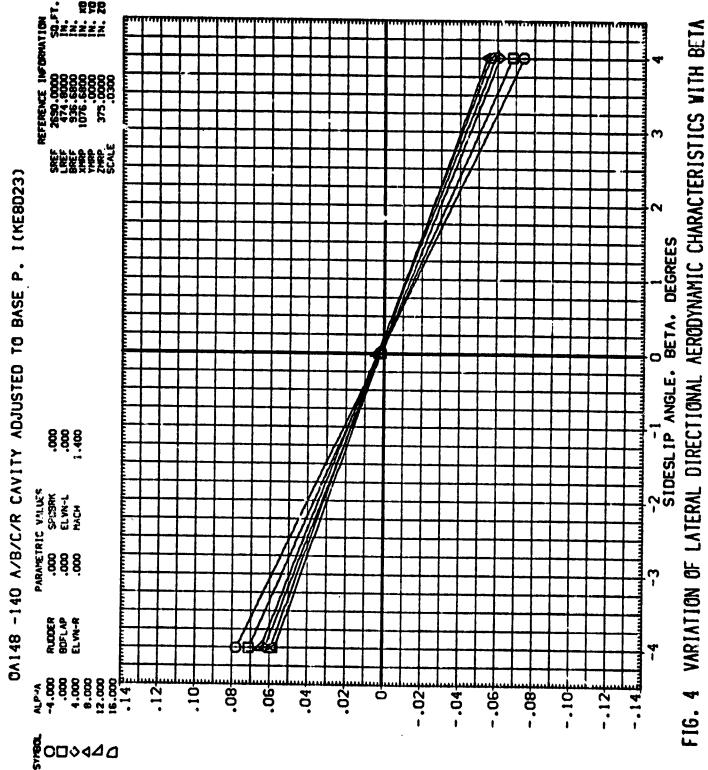
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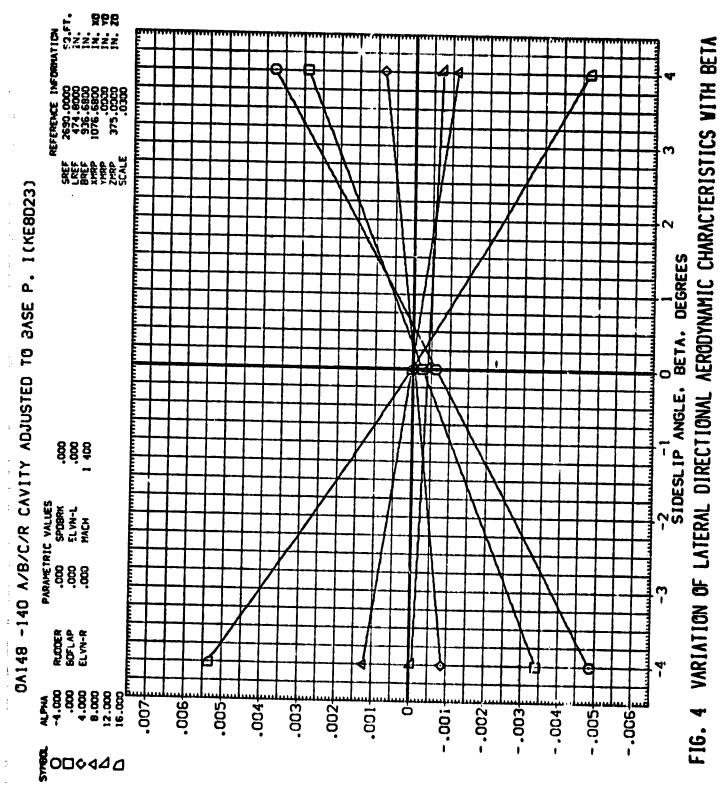
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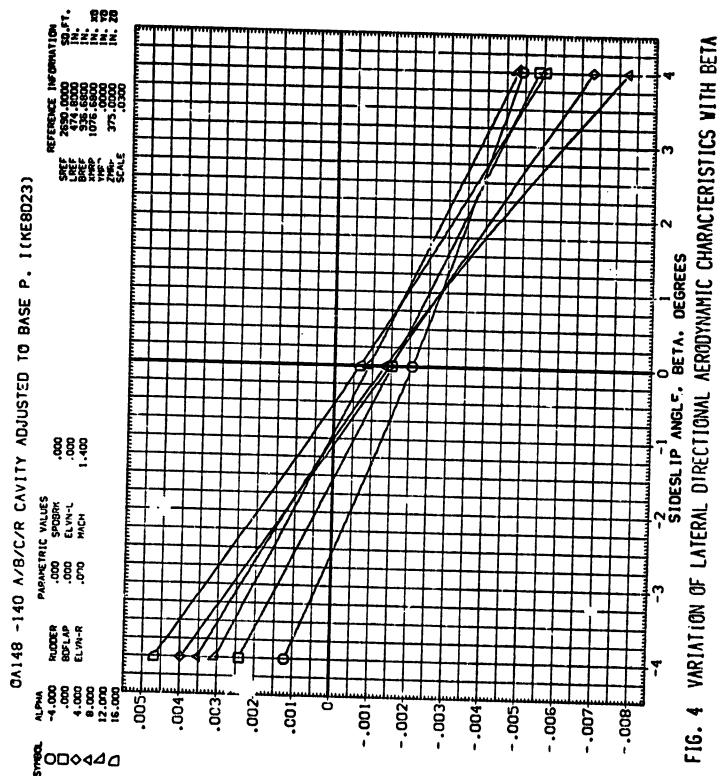
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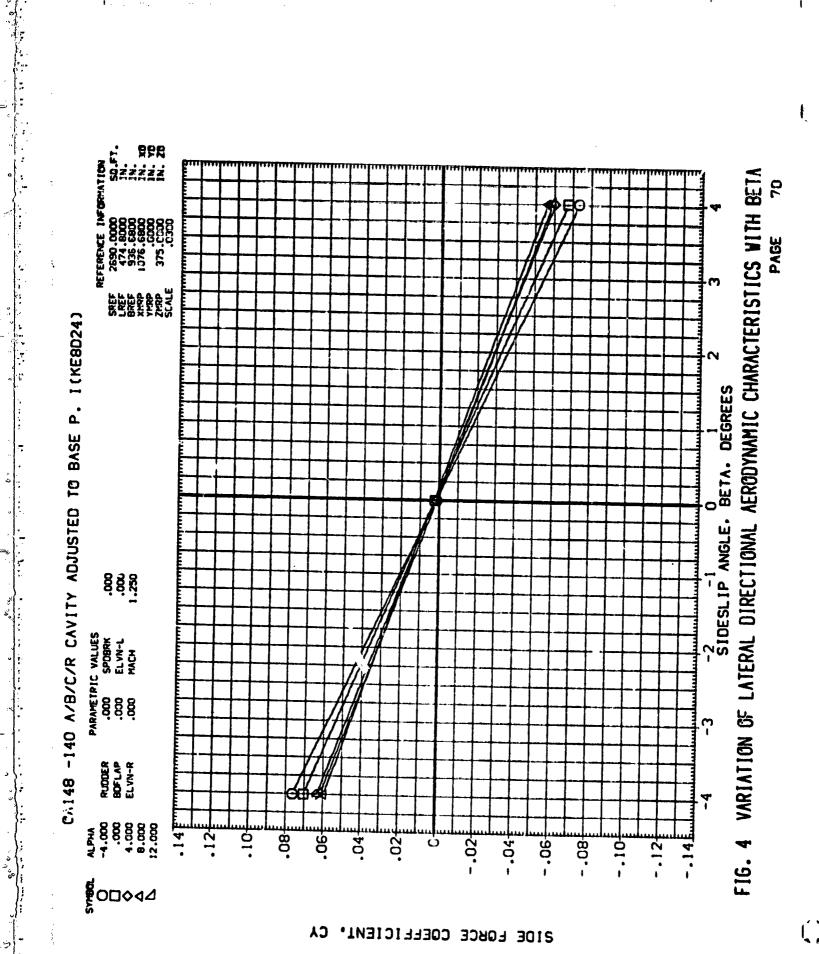


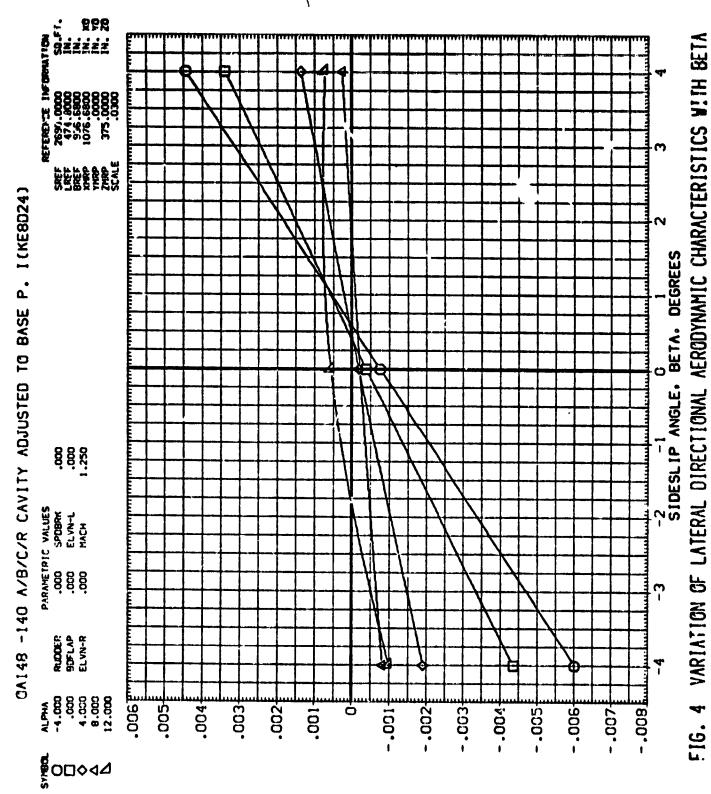


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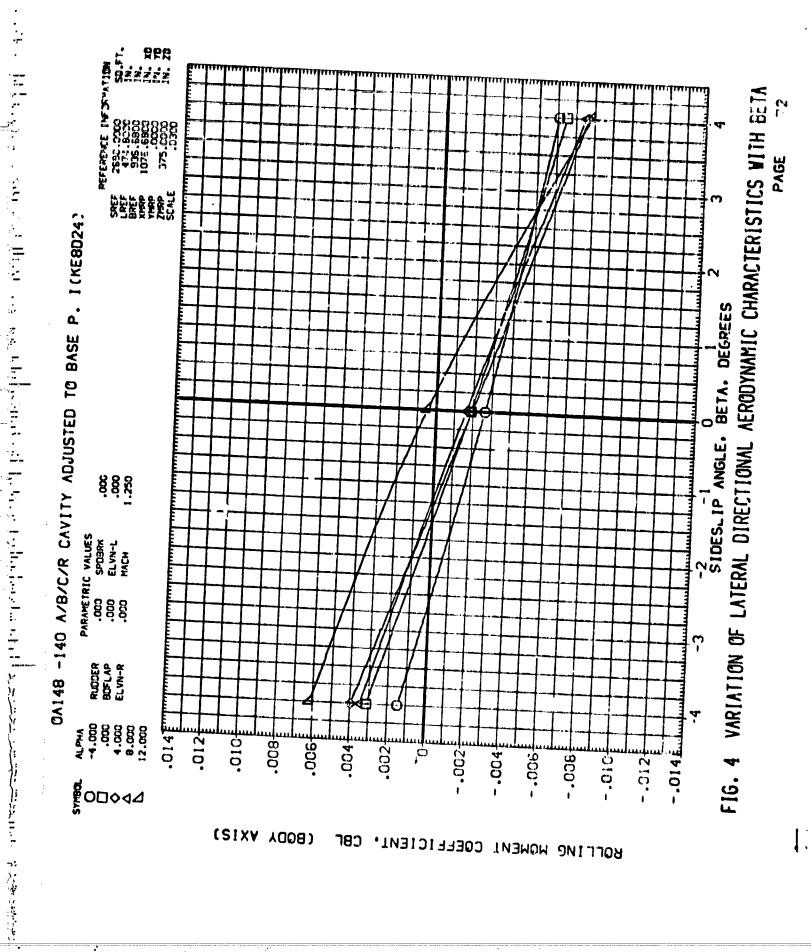


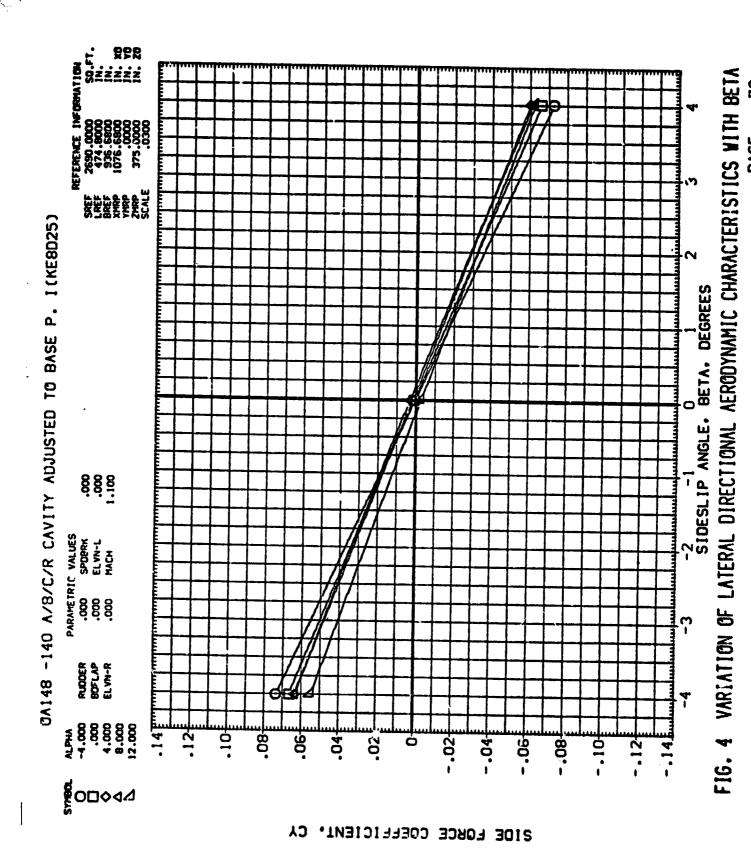


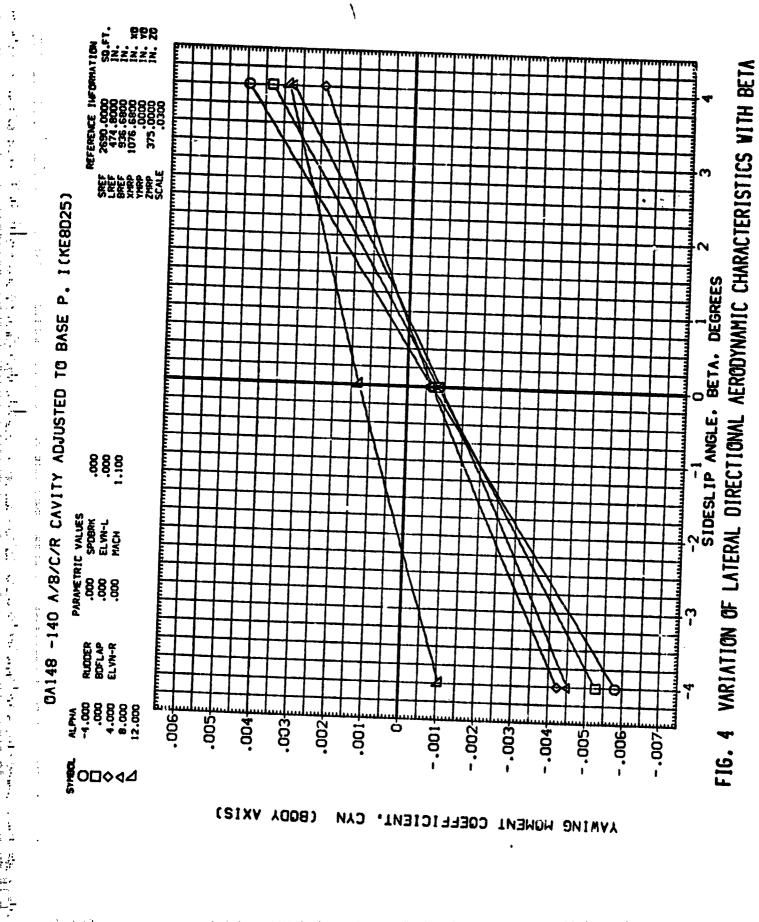
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7 25690,0000 1N. 474,8000 1N. 835,6800 1N. 8100 1N. 810 1075,6800 1N. 810 1075,0000 1N. 810 1075,0 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA SCALE SCALE SCALE OA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I(KE8D25) -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES 885 PARAYETRIC VALUES
.000 SPOBRK
.000 ELVN-L RUDDER BOFLAP ELVN-R ALPHA -4.000 .000 4.000 12.000 .014 ₹800° -.014島 .012 -010<del>-</del> .00e .004 -.002 -.010 .002 -.004 -.008 0 -.006 -.012 **№**0□◊47

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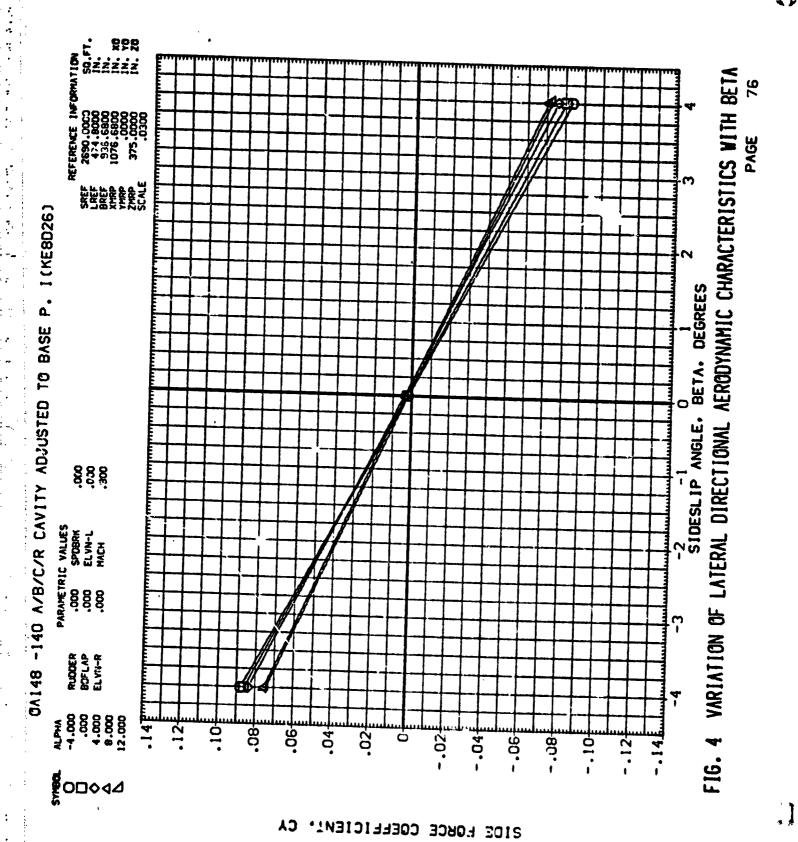
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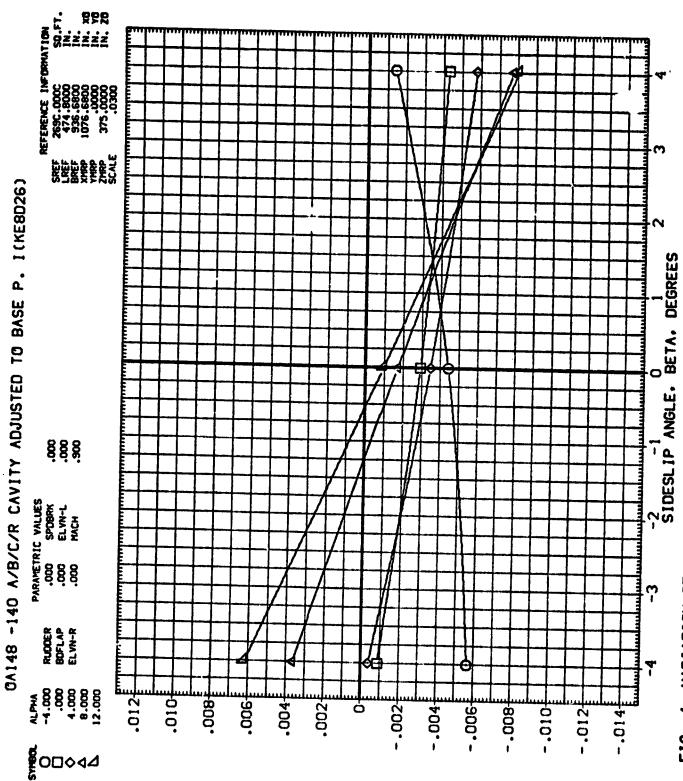
2690.0000 2690.0000 474.8000 1076.6800 175.0000 SREF LREF BREF XMRP XMRP XMRP SCALE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I(KE8D26) -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES 888 PARAMETRIC VALUES
.000 SPOBRK
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE



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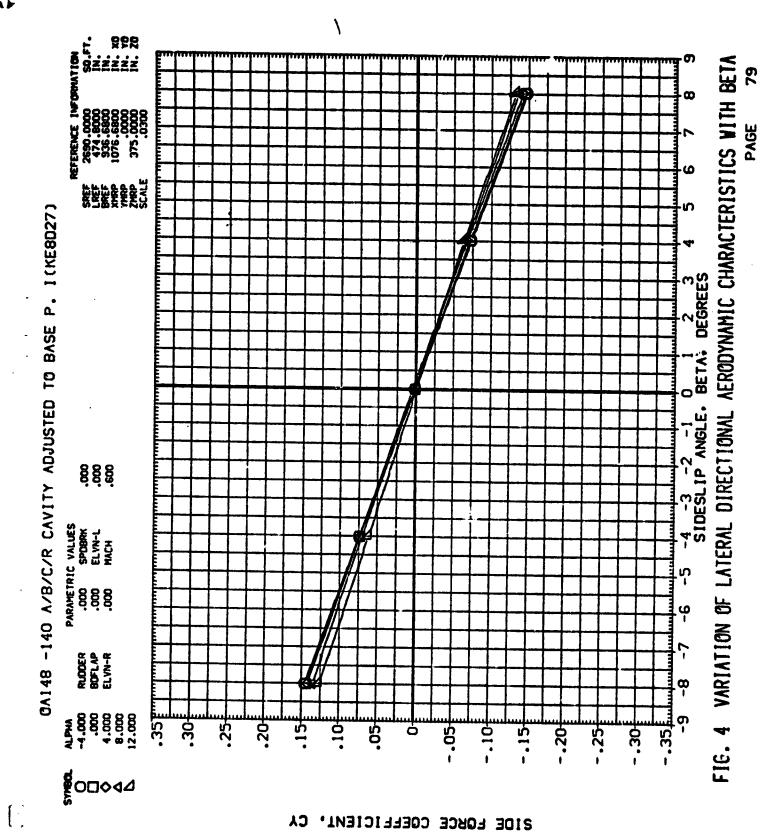
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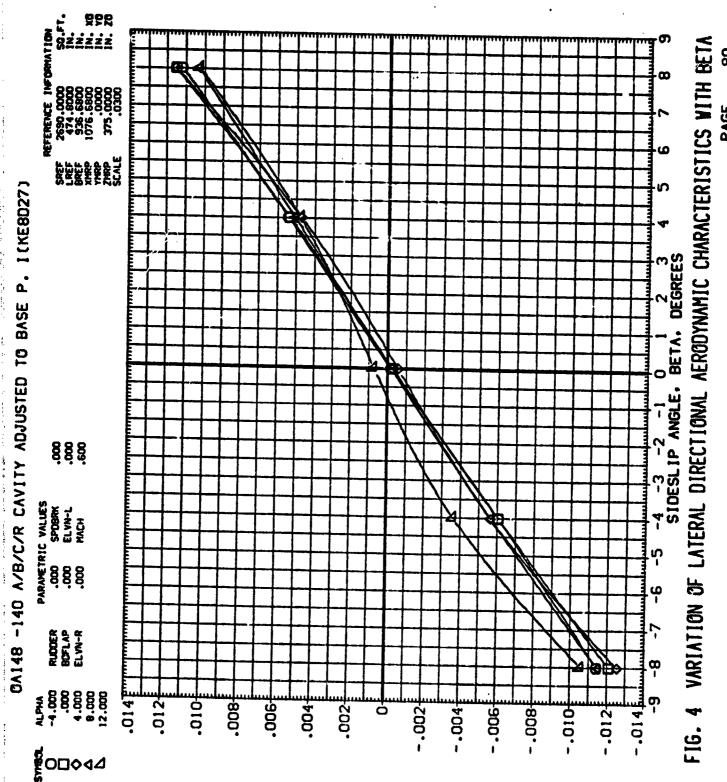
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE

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.000 SPDB9K
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

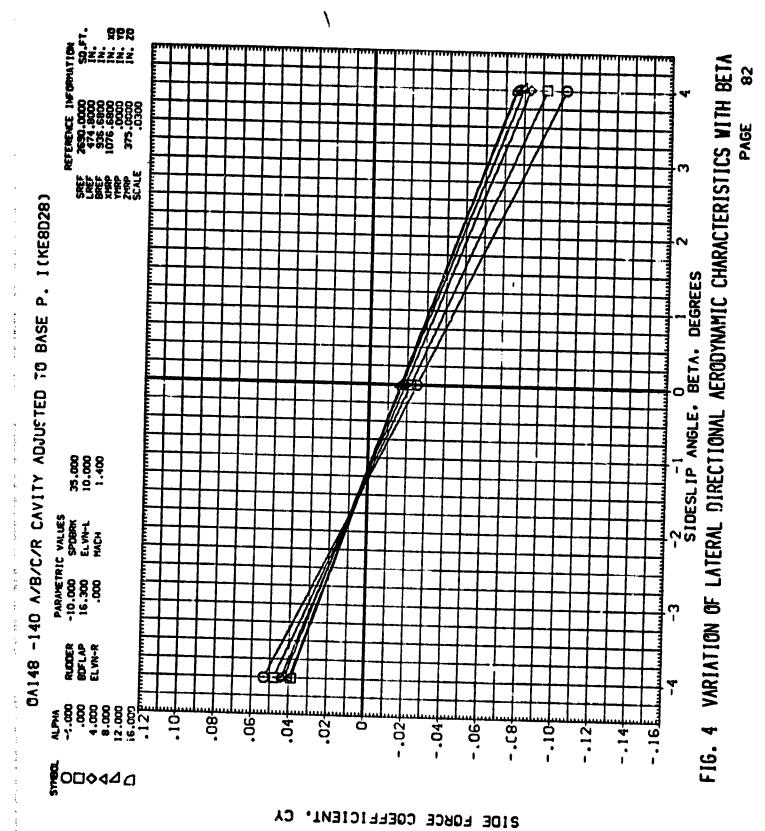
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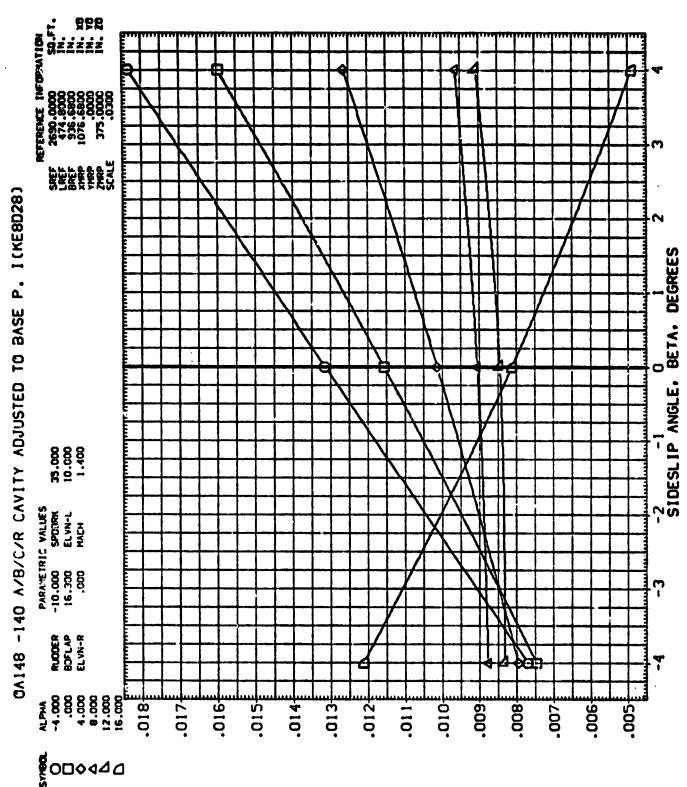
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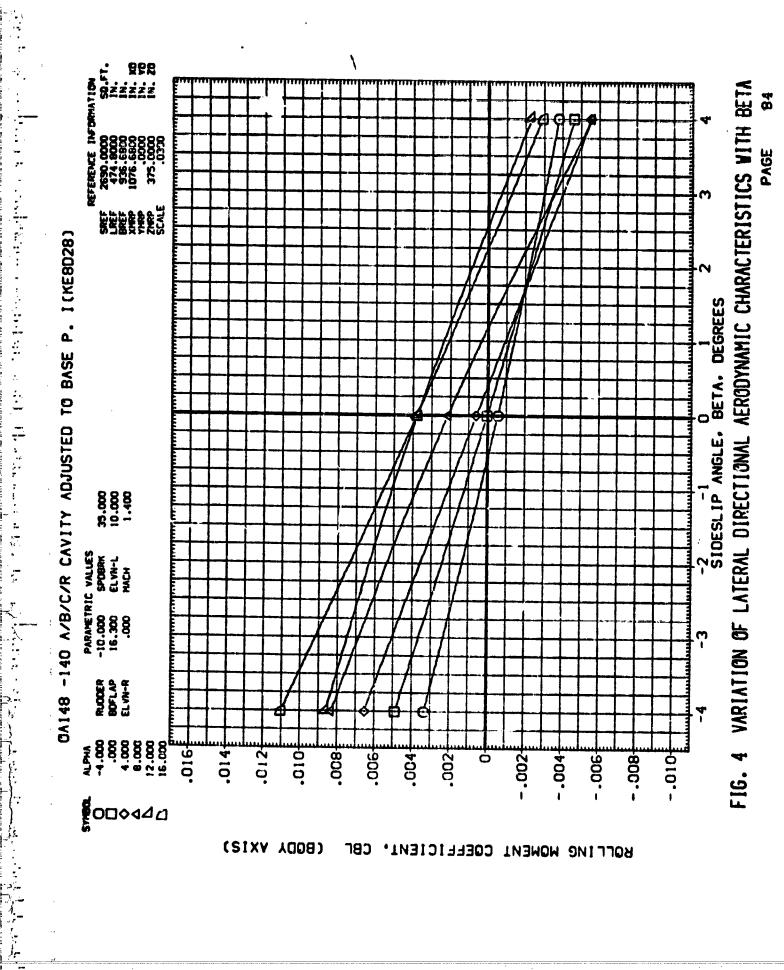
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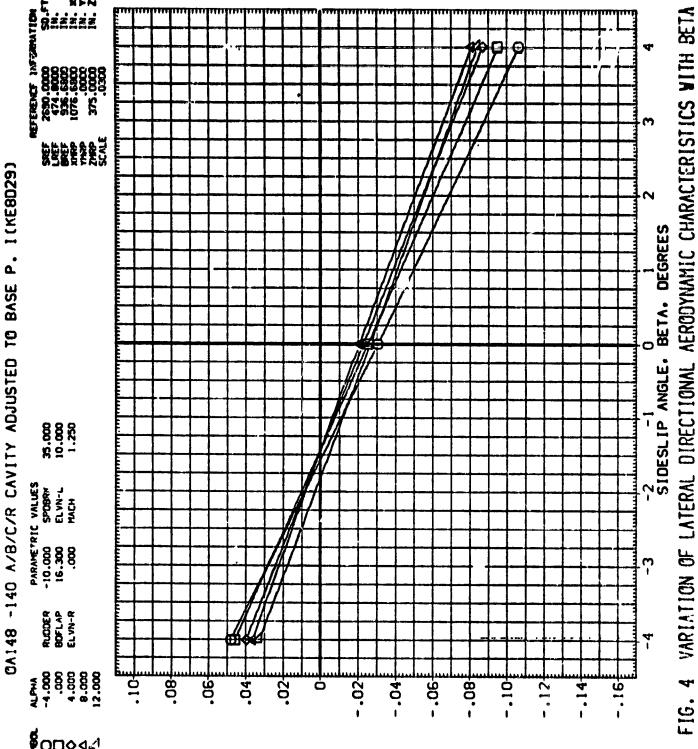
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE



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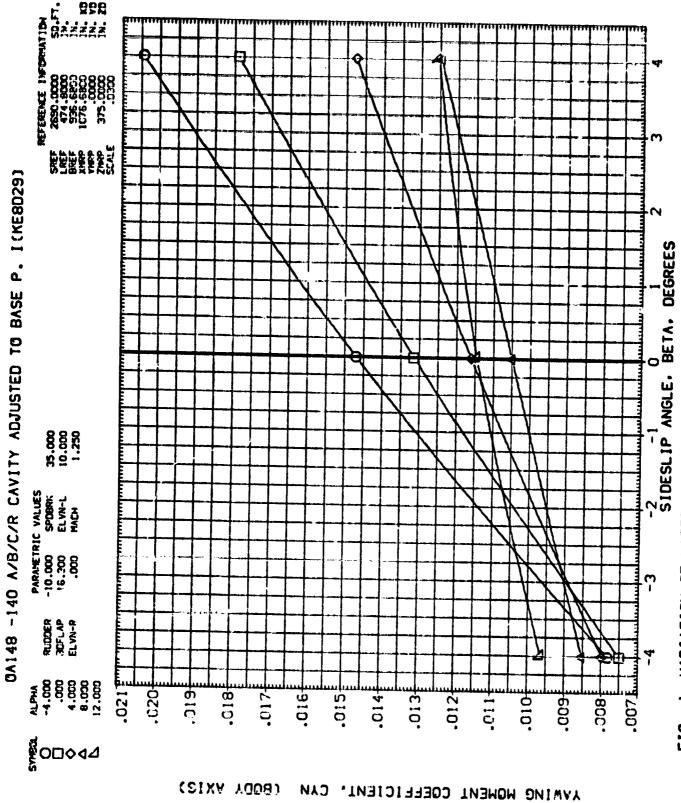
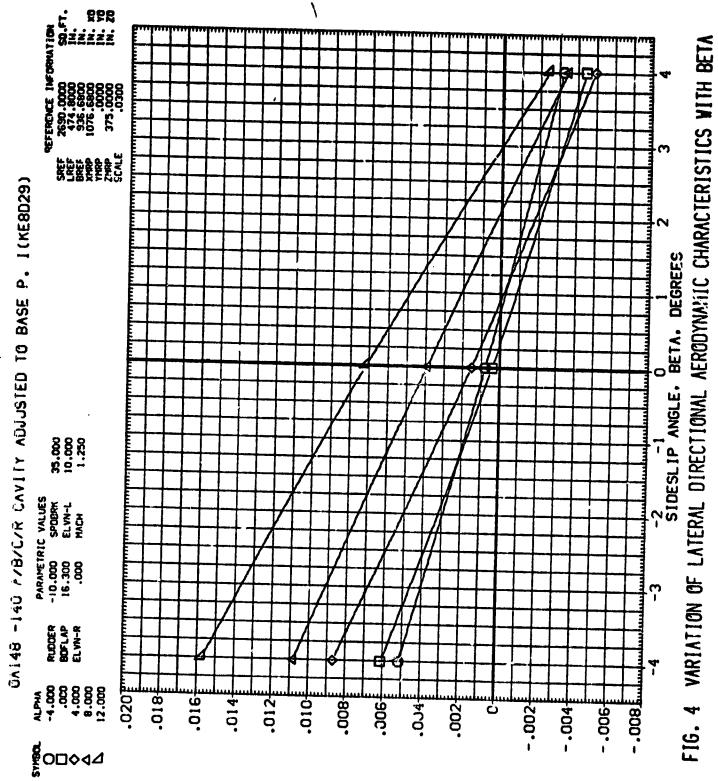


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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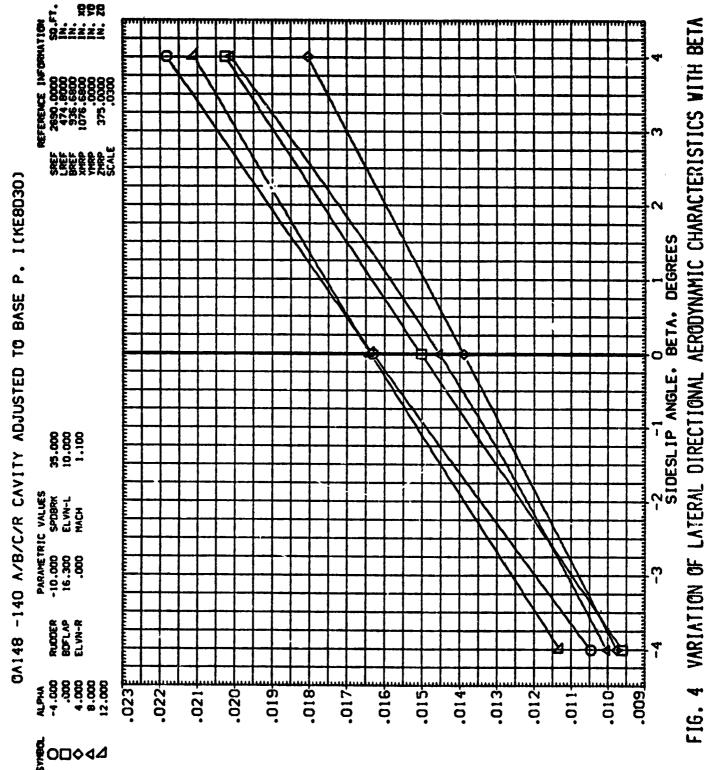
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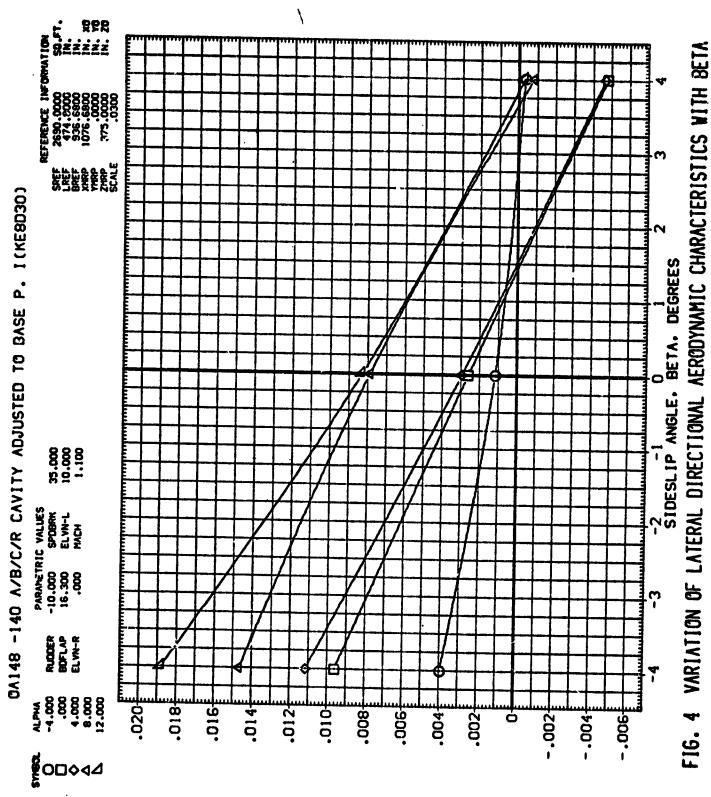
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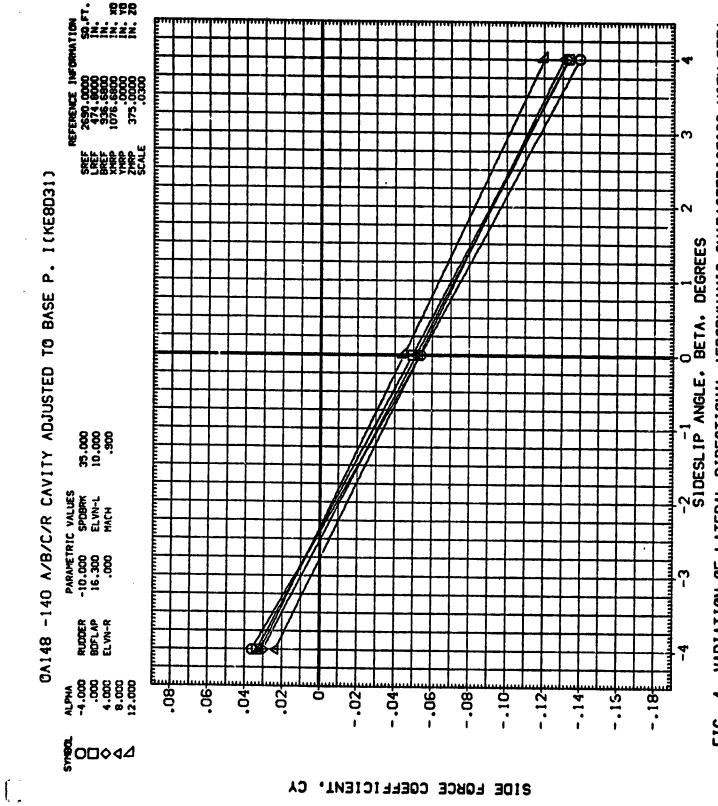


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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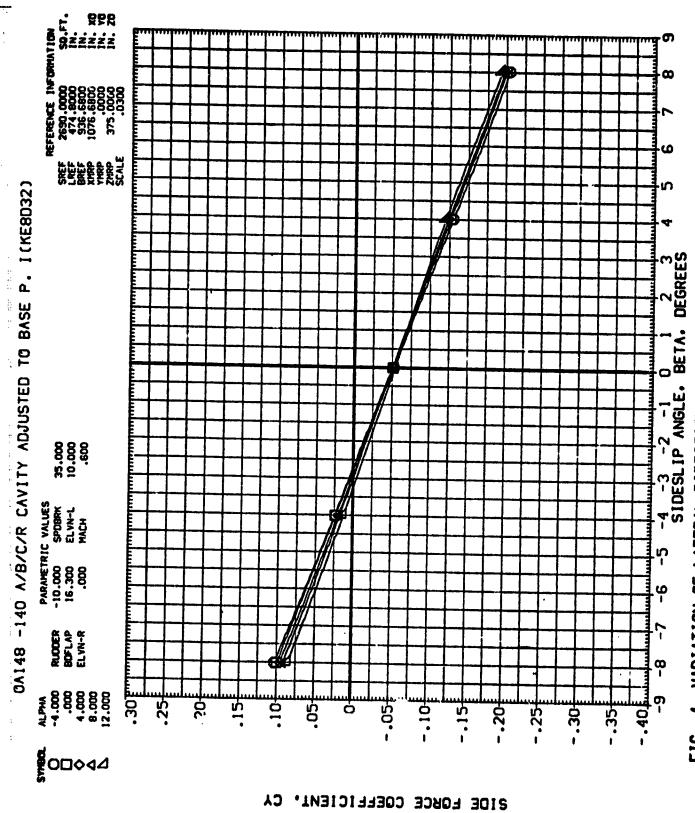
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REFERENCE INFO 2690-0000 474-8800 1076-6800 375-0000 6 375-0000

FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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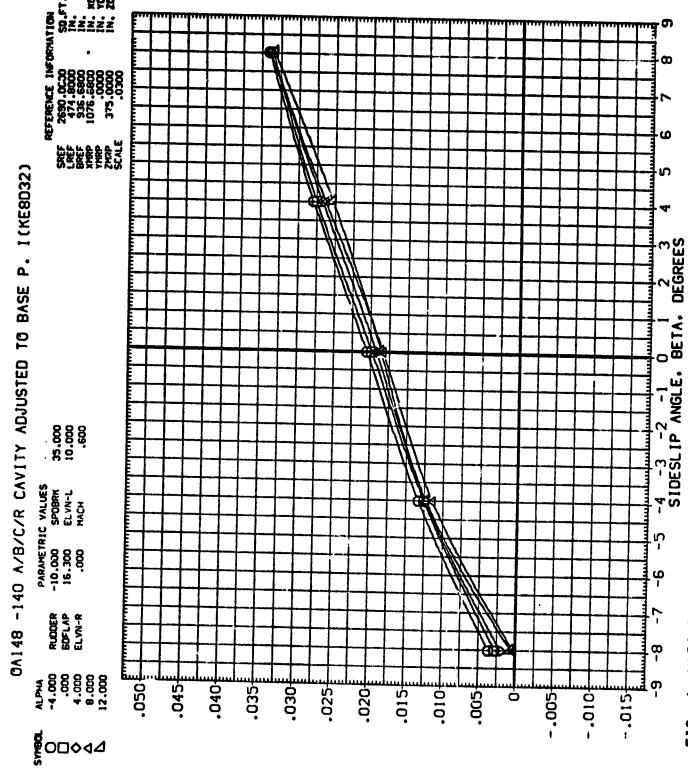
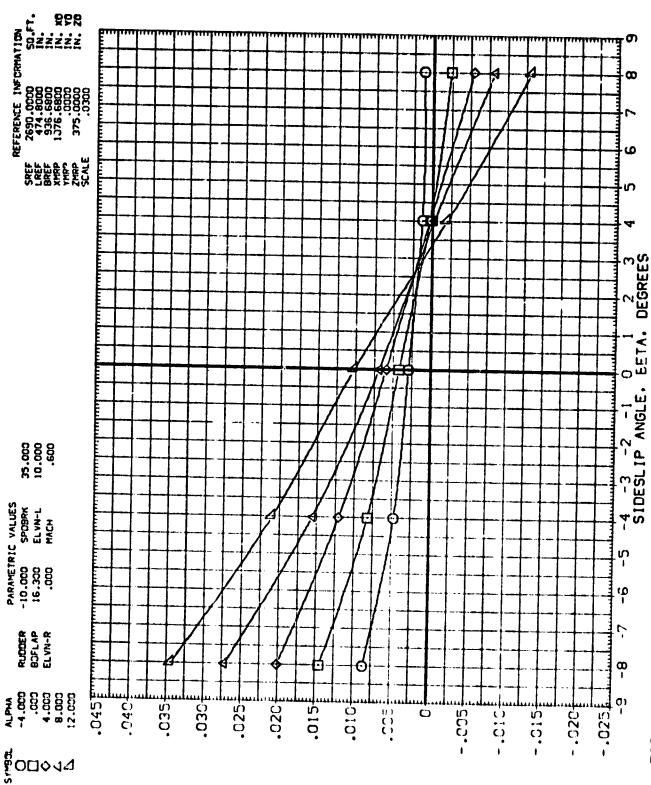


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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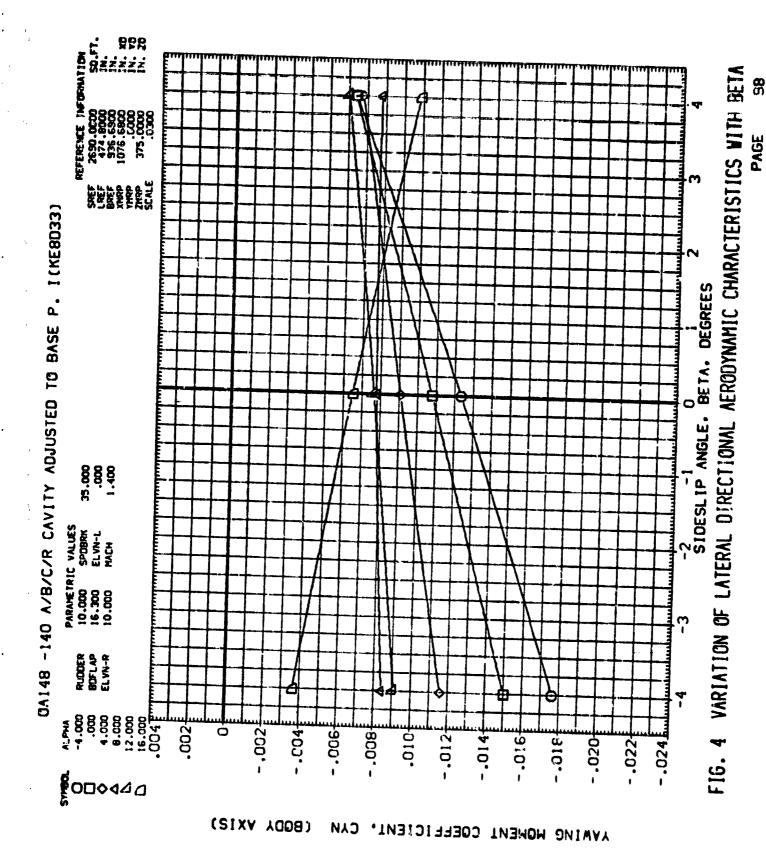
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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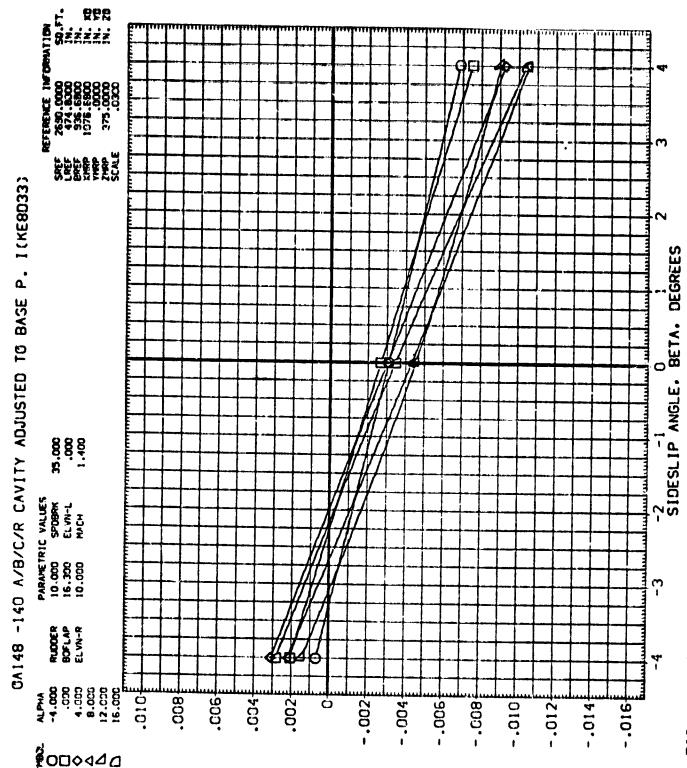
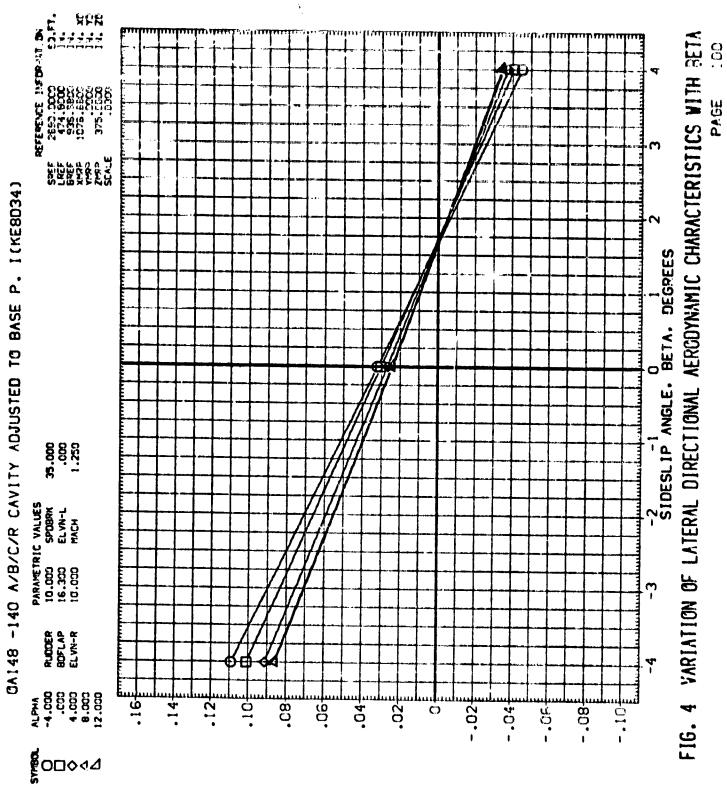


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAHIC CHARACTERISTICS WITH BETA 101 PAGE

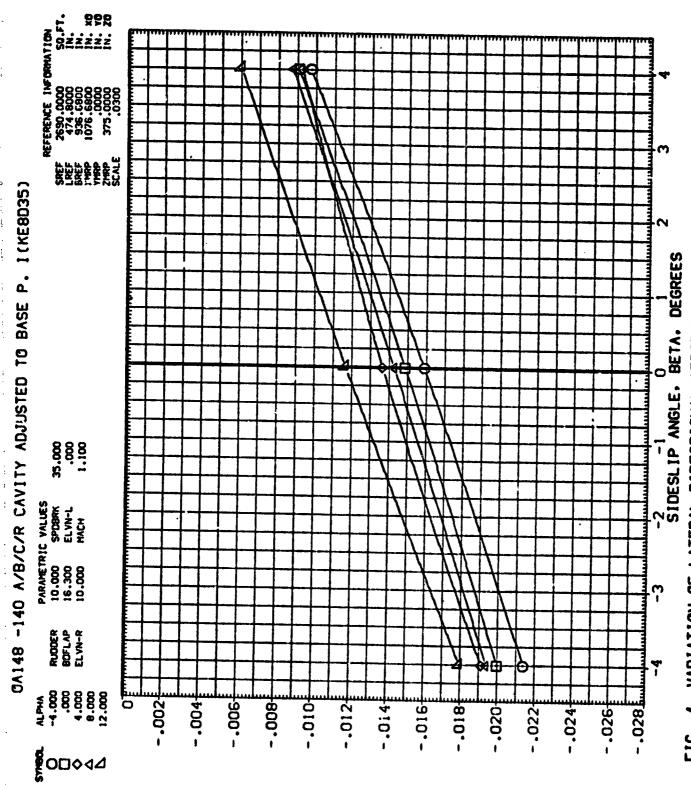
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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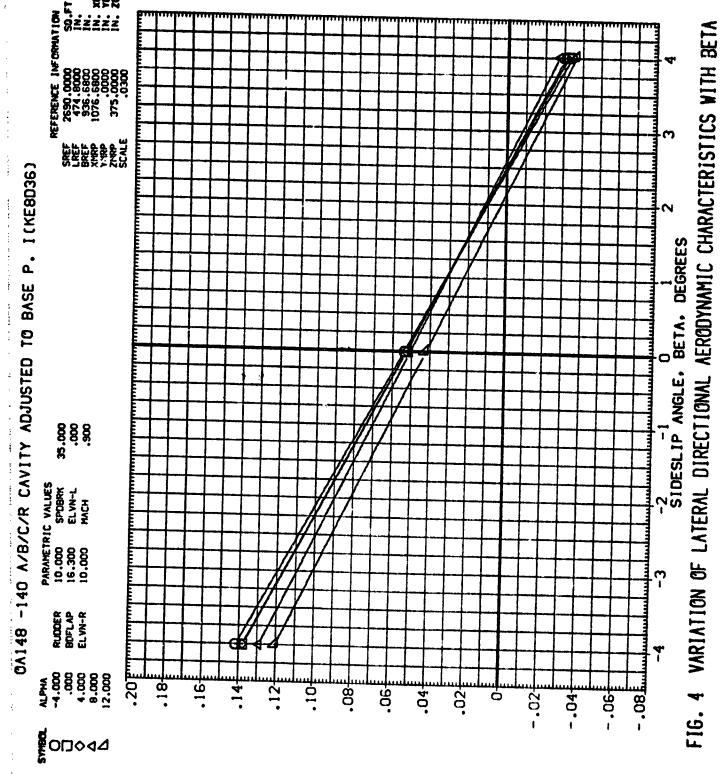
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10.000 SPOBRK
16.300 ELVN-L
10.000 MACH RUDGER BOFLAP ELVN-R ALPHA -4.000 .000 4.000 8.000 -.010<del>£</del> -.012<del>{</del> -.014 -.008 -.018<del>∮</del> -.016 -.020 -.022 -.024 -.026 -.028 .030 -.032 -.034 -.036 **№**0□◊44

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE

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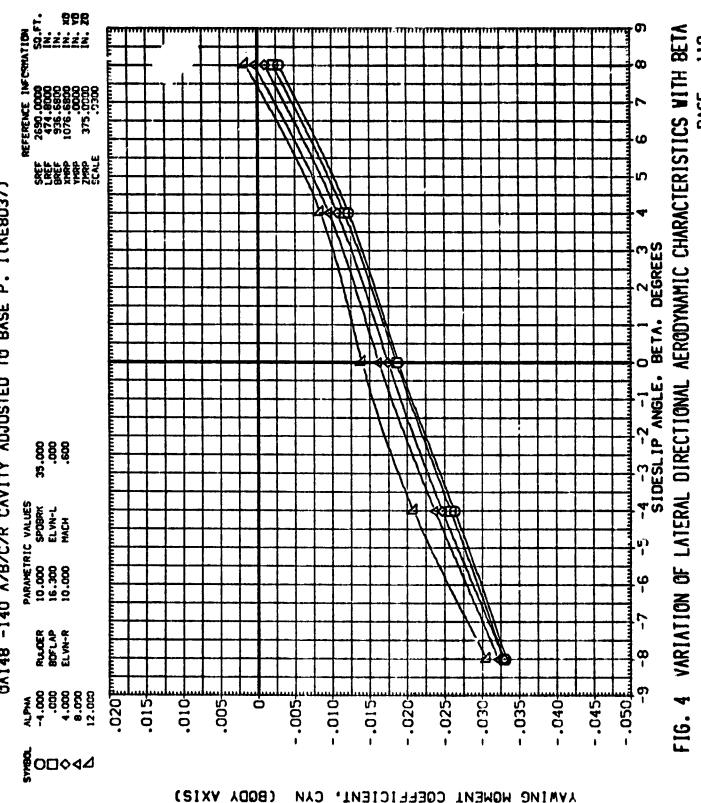
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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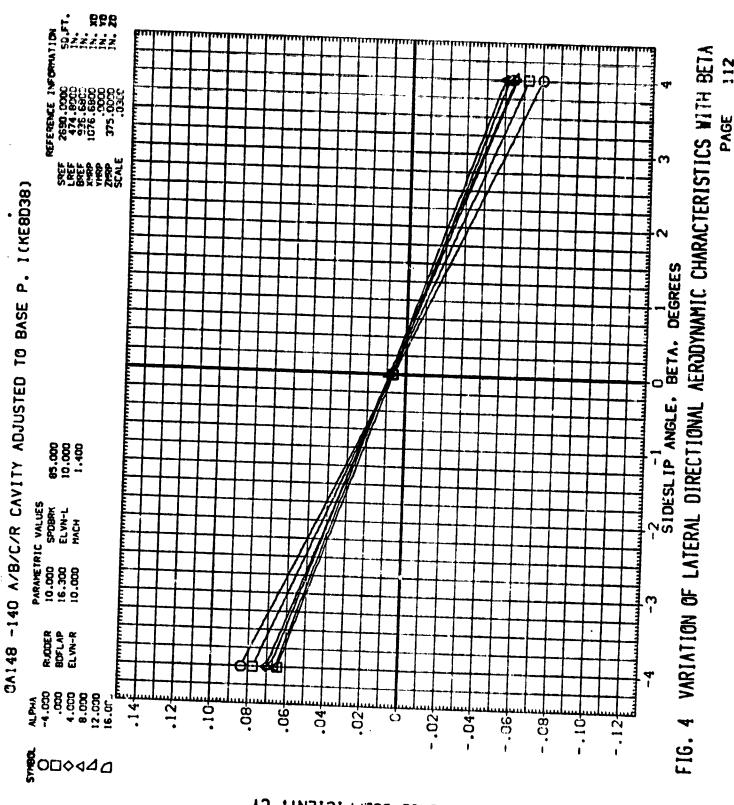
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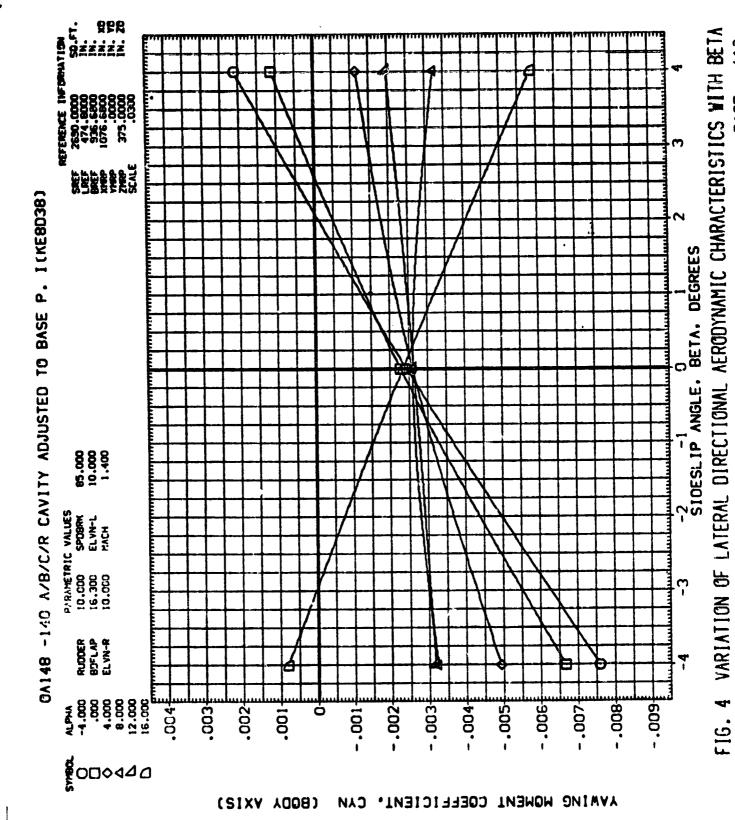
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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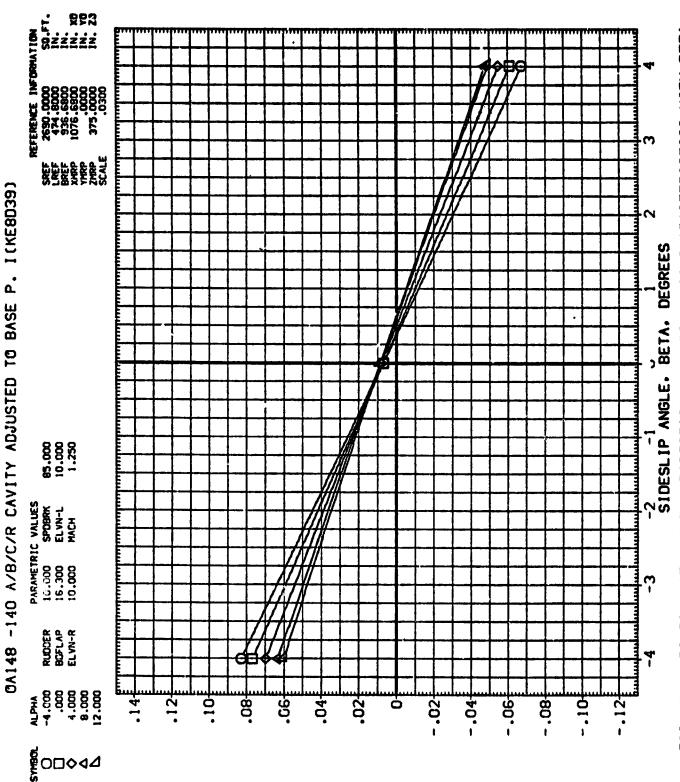


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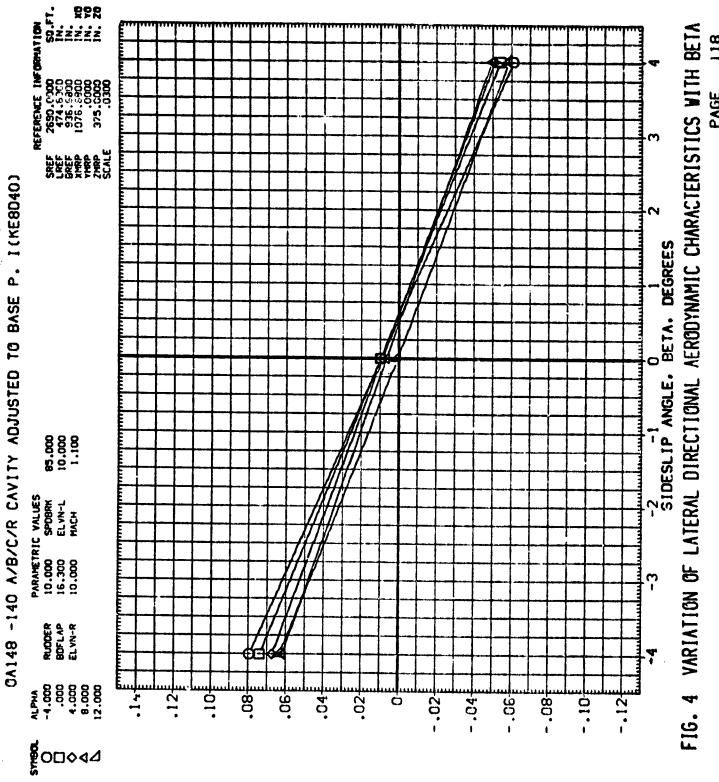
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES

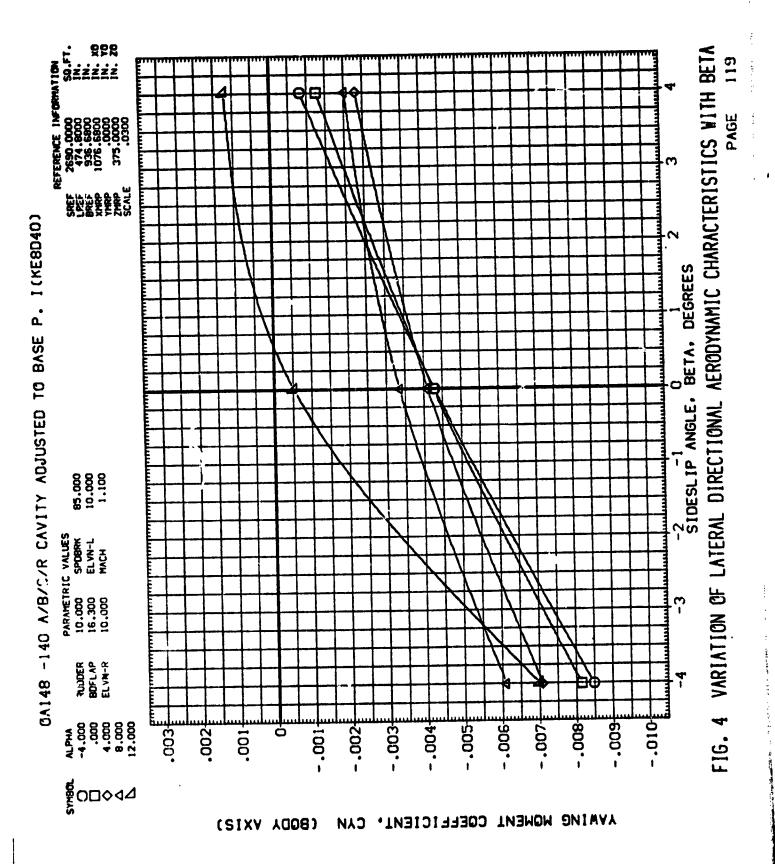
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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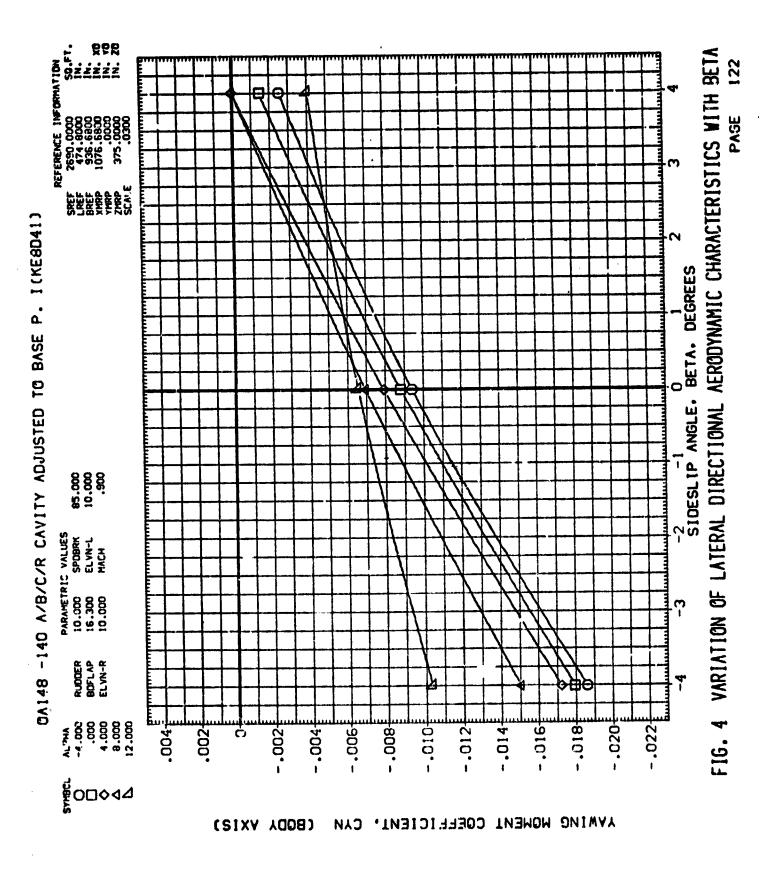


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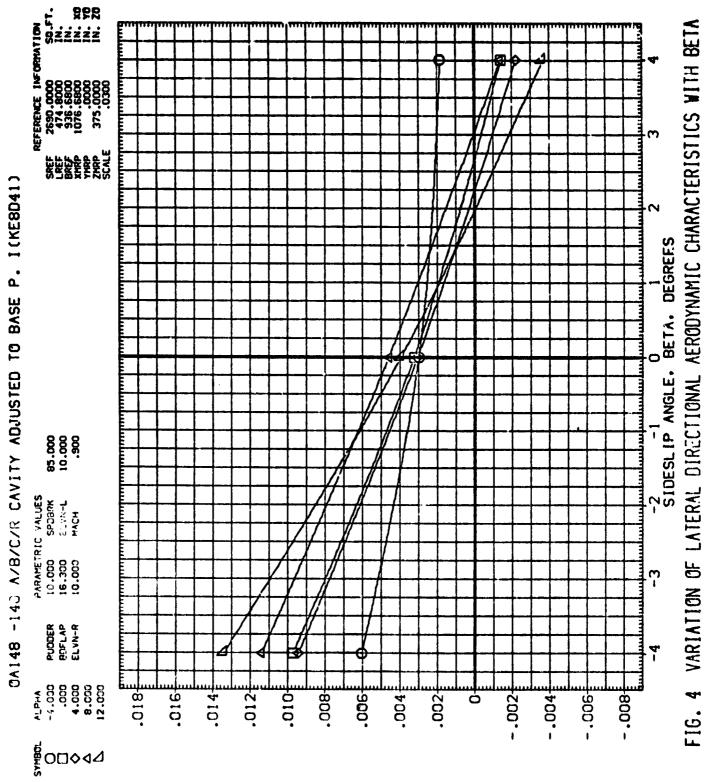
8xxxxx F. 858 REFERENCE INFORMATION VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 2690.0000 474.8000 936.6800 1976.6600 375.0000 SREF LREF BREF XMRP YHRP ZMRP SCALE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I(KE8D40) -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES 95.000 10.000 1.100 PARAMETRIC VALUES 10.000 SPOBRK 16.300 ELVN-L 10.000 MACH RUDDER BOFLAP ELVN-R 4.000 4.000 12.000 .020更 .018<del>[</del> -016€ -014年 .012£ .010<del>4</del> ±800· ·006年 .004卡 -002春 FIG. 4 -.008<u>E</u> -.002 -.004€ ₹900`-0 **₹**0□◊4△ (SIXV ADD8) CBF ROLLING MOMENT COEFFICIENT,

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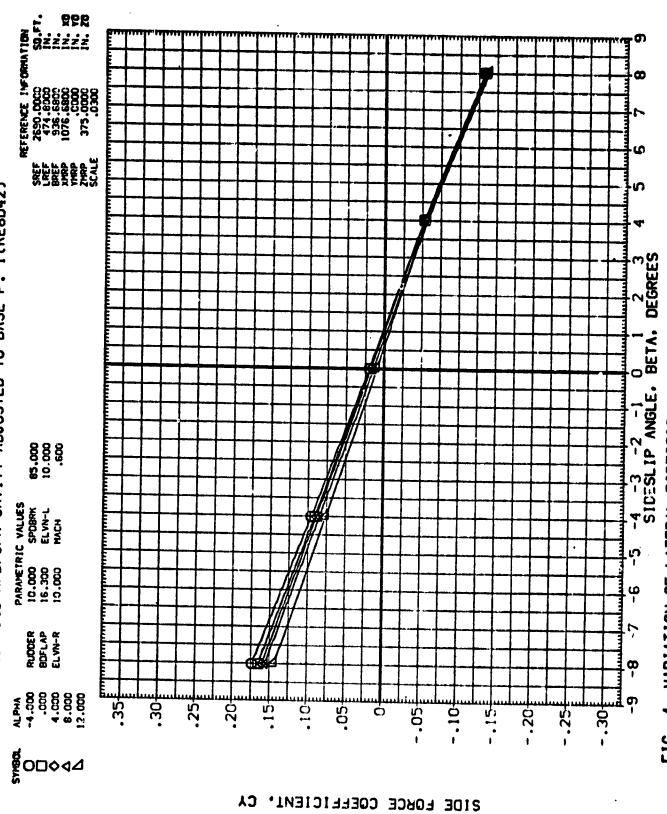
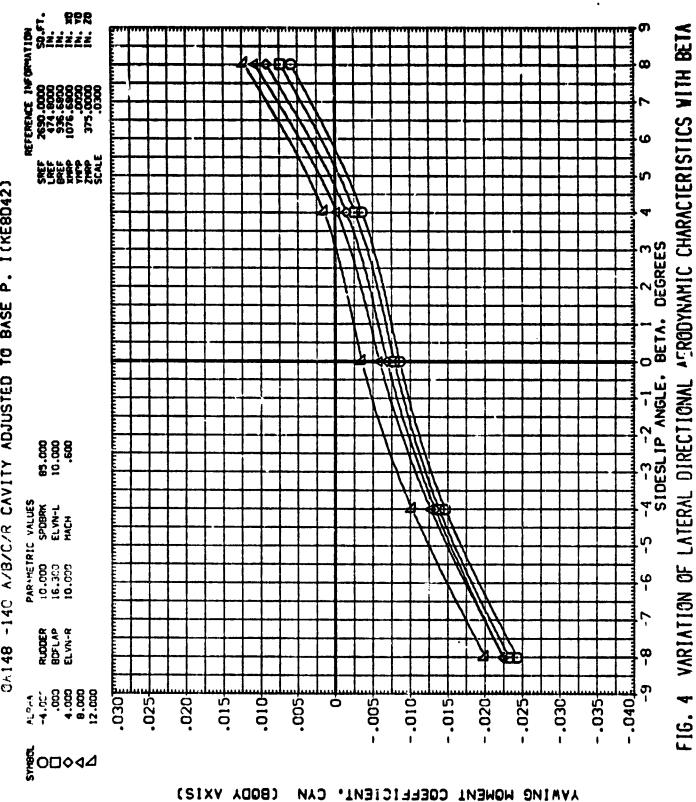


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 124

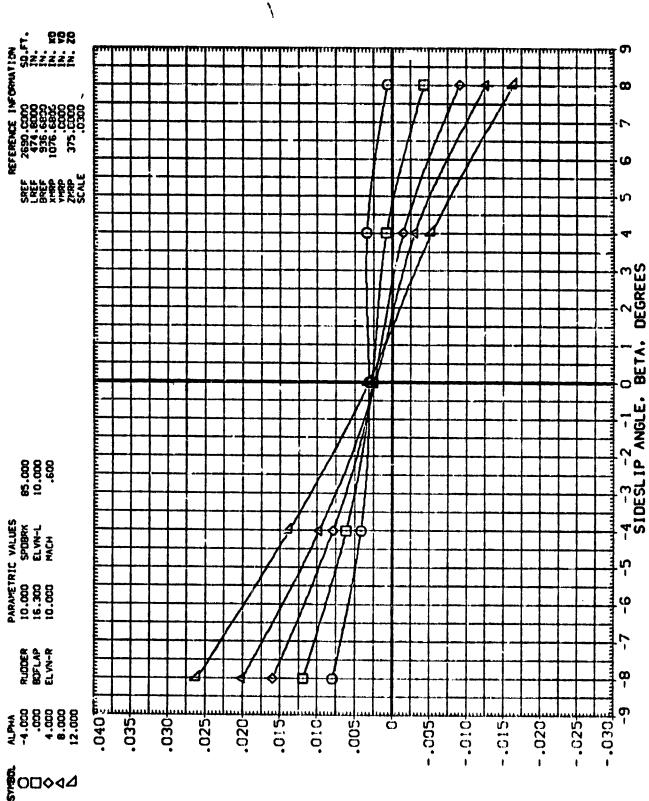
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GA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. ICKE8D423



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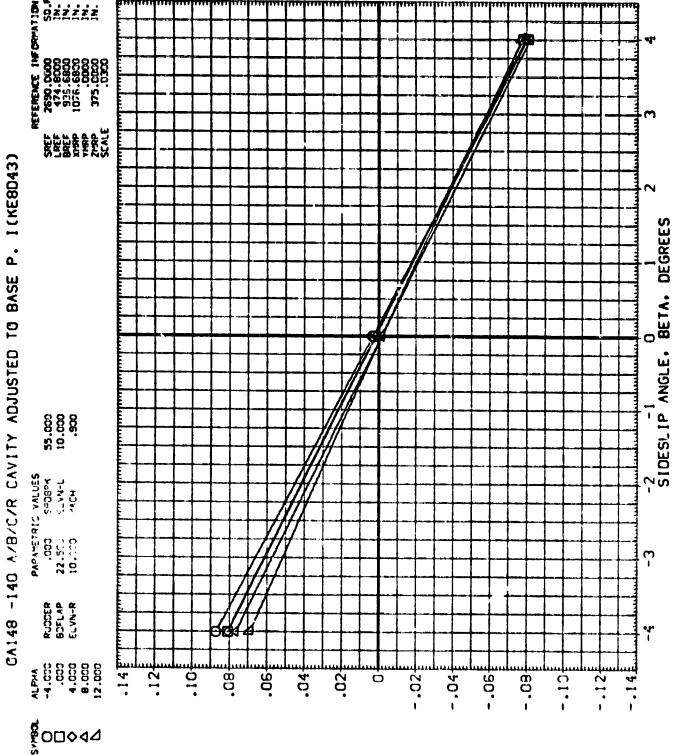
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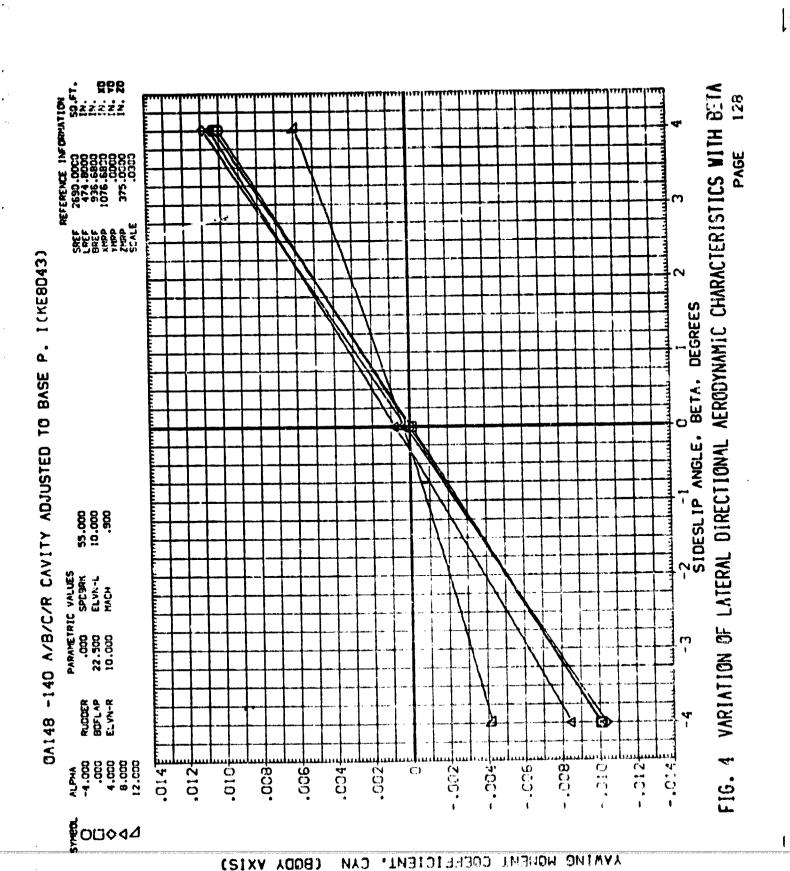
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VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE F16. 4



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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

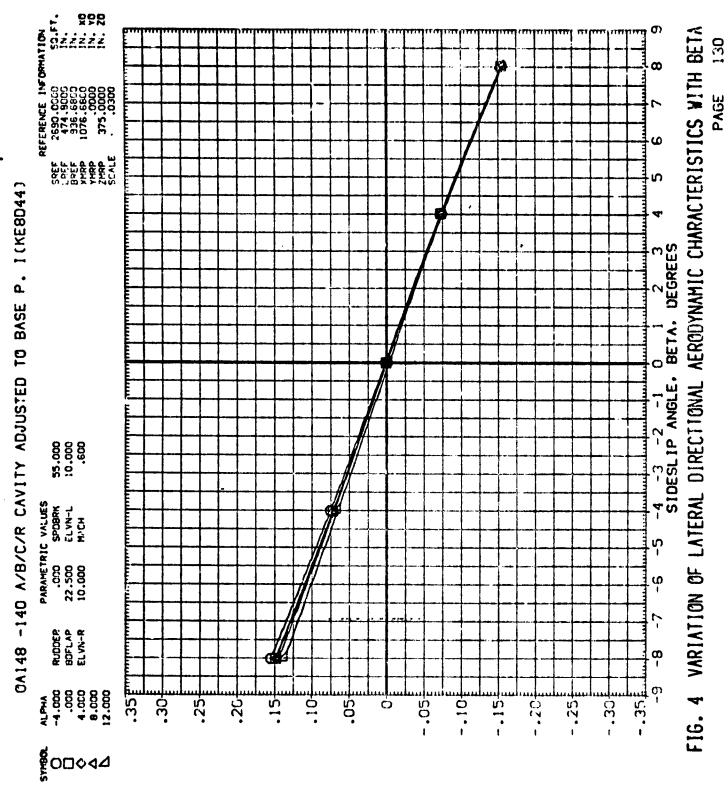


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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



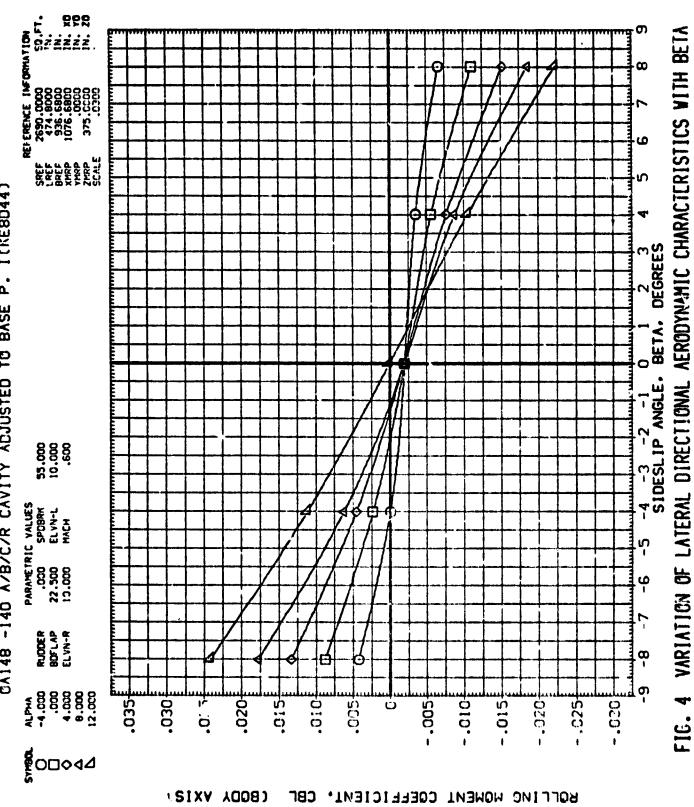
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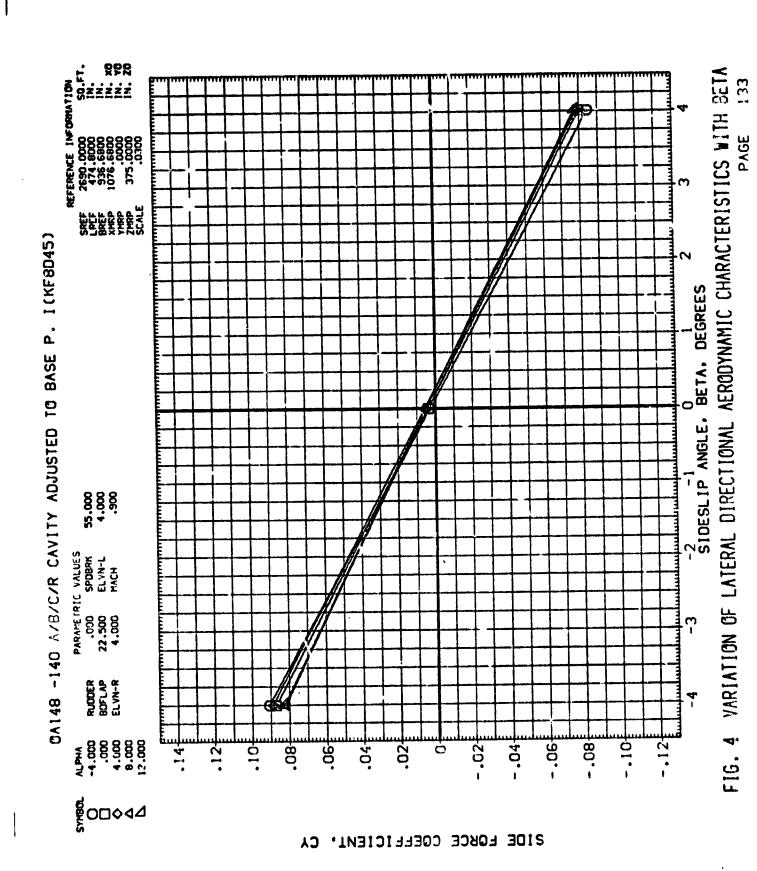
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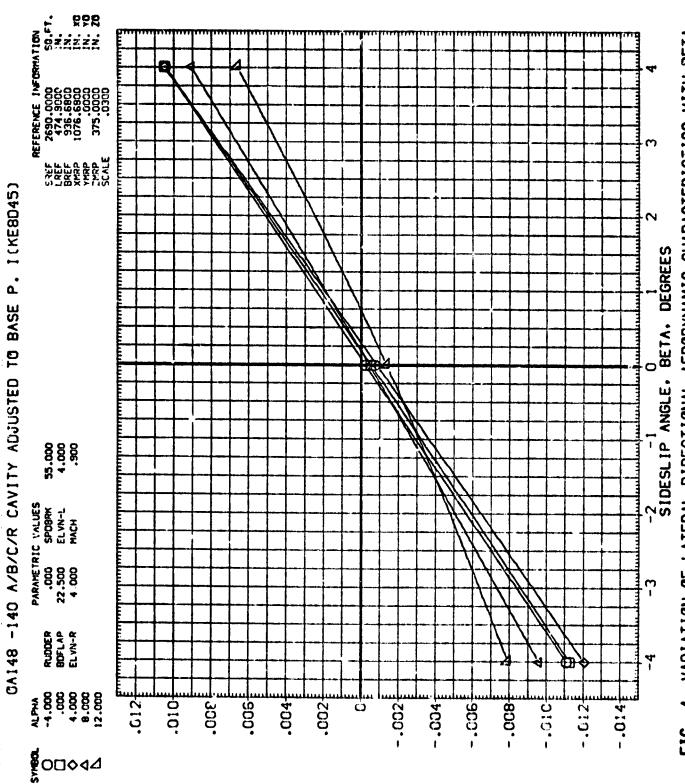
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 131 PAGE

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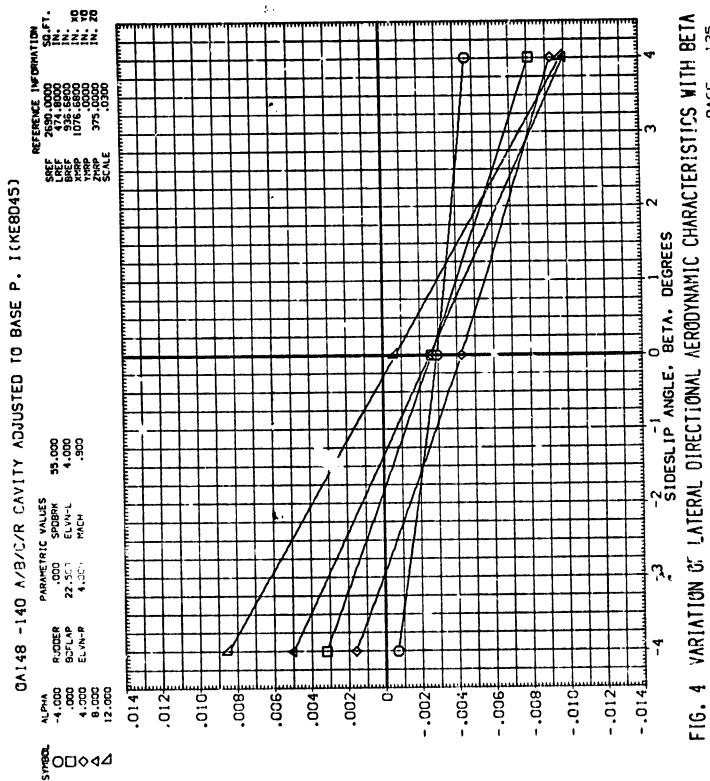


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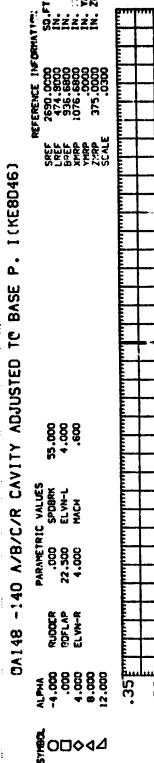
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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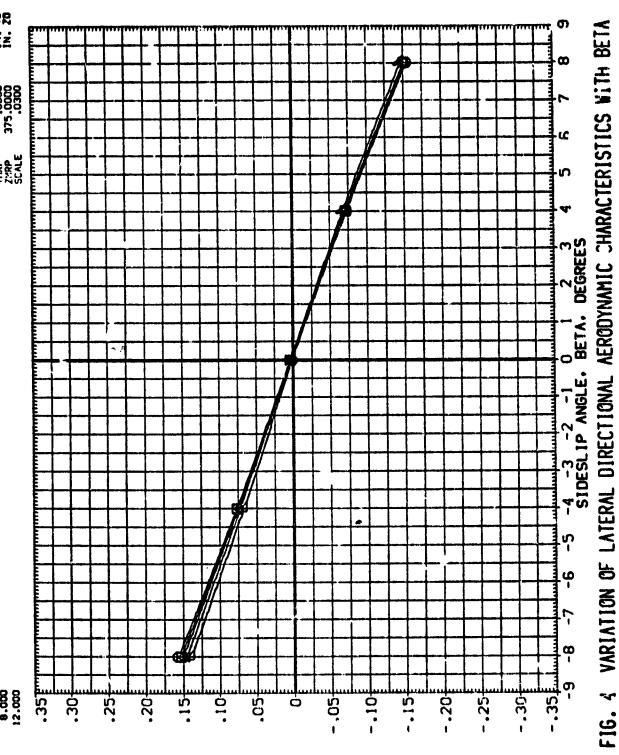
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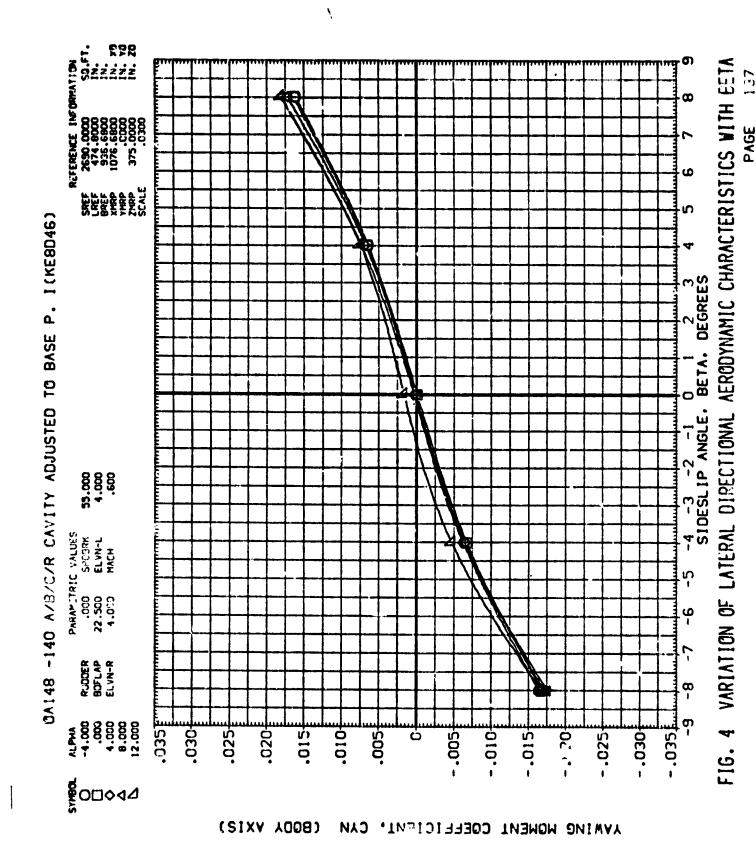
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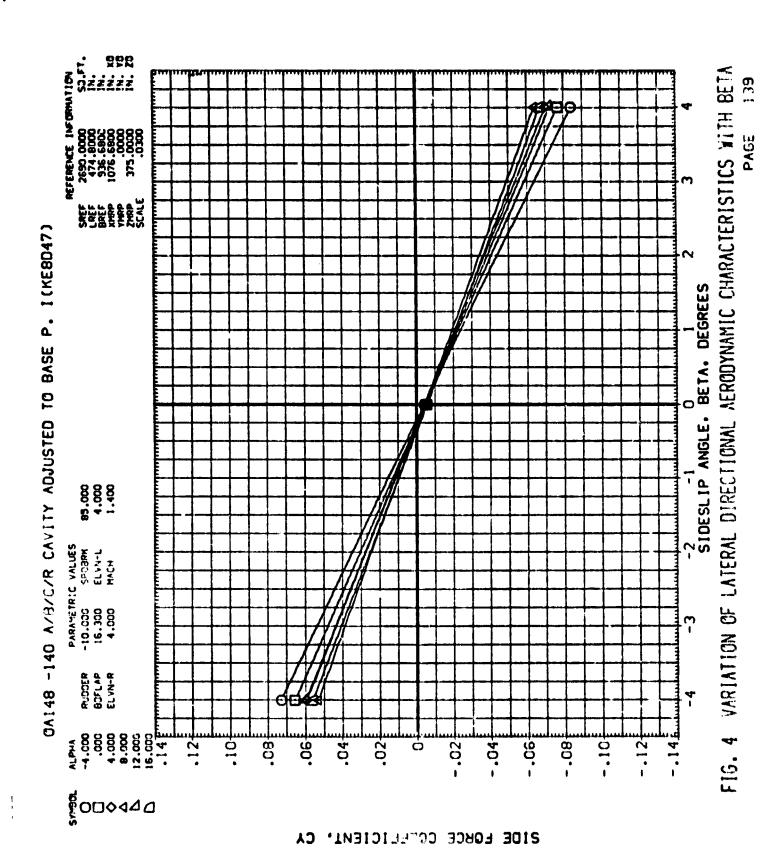
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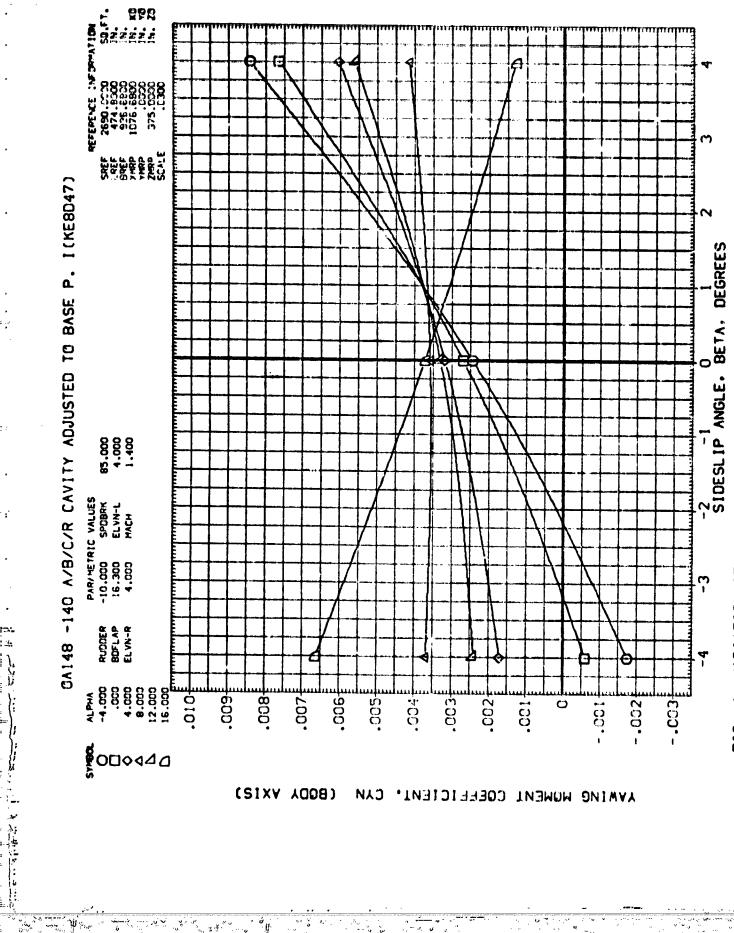
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PASE

FIG. 4 JARIATION OF LATERAL DIRECTIONAL AERONYNAMIC LHARACTERISTICS WITH BETA 26.5.6900 936.6800 936.6800 936.6800 935.6900 935.6900 935.6900 SAEF RIPE VIND VIND SCALE SCALE DA148 -140 AZBZCZR CAVITY ADJUSTED TO BASE P. (KE8D47) DEGREES SIDESLIP ANGLE, BE. 85.000 4.000 1.400 PARANETRIC VALLES -10.003 SPORK 16.303 ELVN-L 4.000 MACH PUDDER BOFLAP ELVN-R -004 010 A. 920 4. 920 8. 920 12. 920 12. 920 ₩800· 到900. -.012 -.004 -.008 -.C10<del>[</del> -.014 -.016 .002 -.002 -.006 Ö **№**0□◊4421

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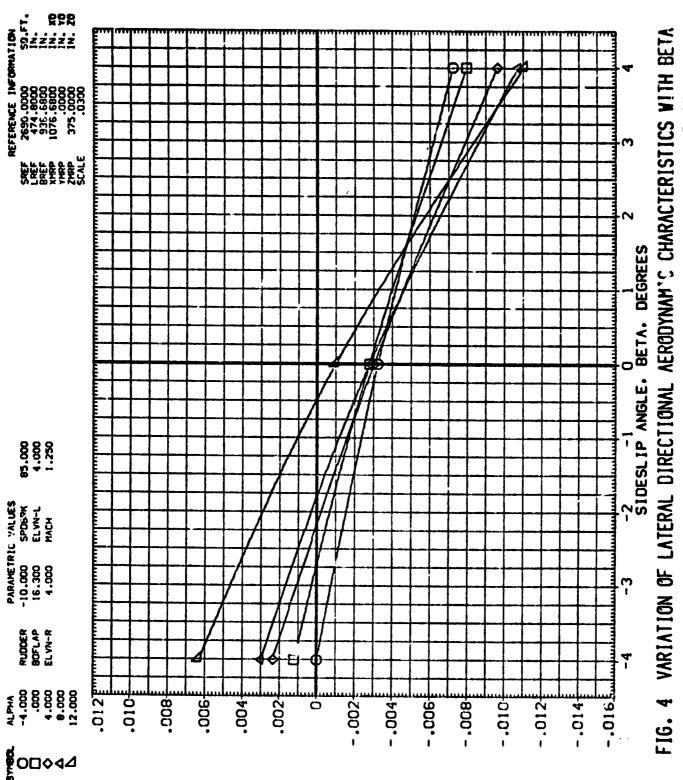
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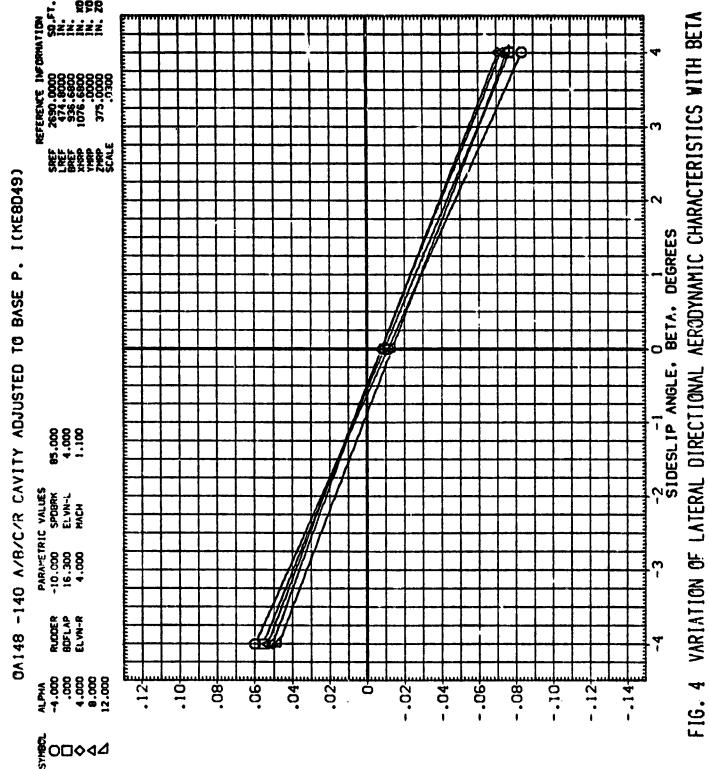
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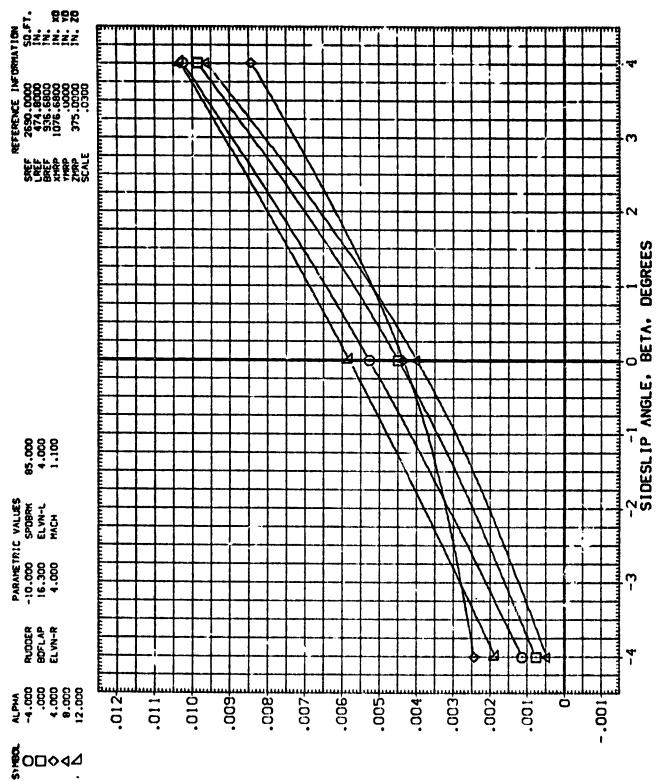
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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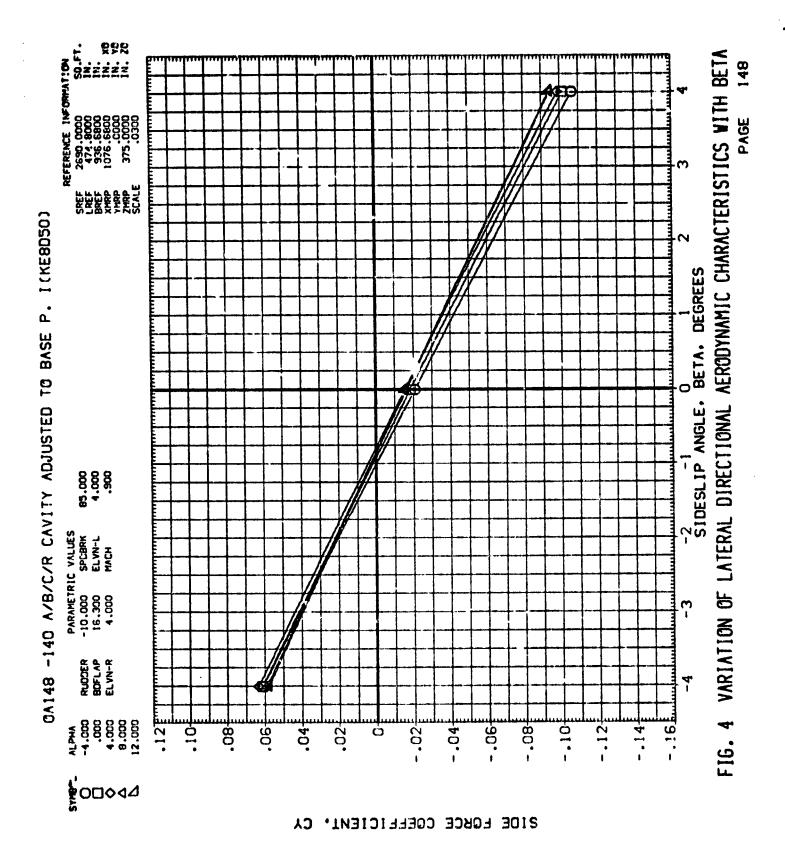
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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SXXXXX F SPR FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 2690.0000 474.0000 936.6800 1076.6800 375.00.0 SCALE SCALE DA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I (KE8D50) 85.000 4.000 900 PARAMETRIC VALUES
-10.GC3 SPOBRK
16.300 ELVN-L
4.003 HACH RUDDER BOFLAP ELVN-R -.004<u>5</u> 4.000 4.000 8.000 12.000 .024百 -010年 .022丰 -020年 .018長 .012 800. **.**006 .004 .002 ò -.002 .016<del>[</del> -0. **№**0□◊4△

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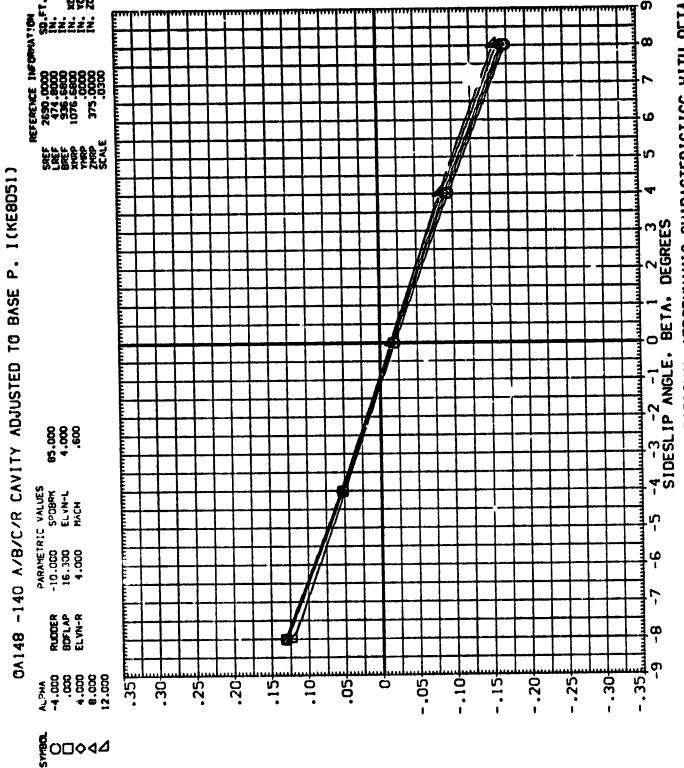
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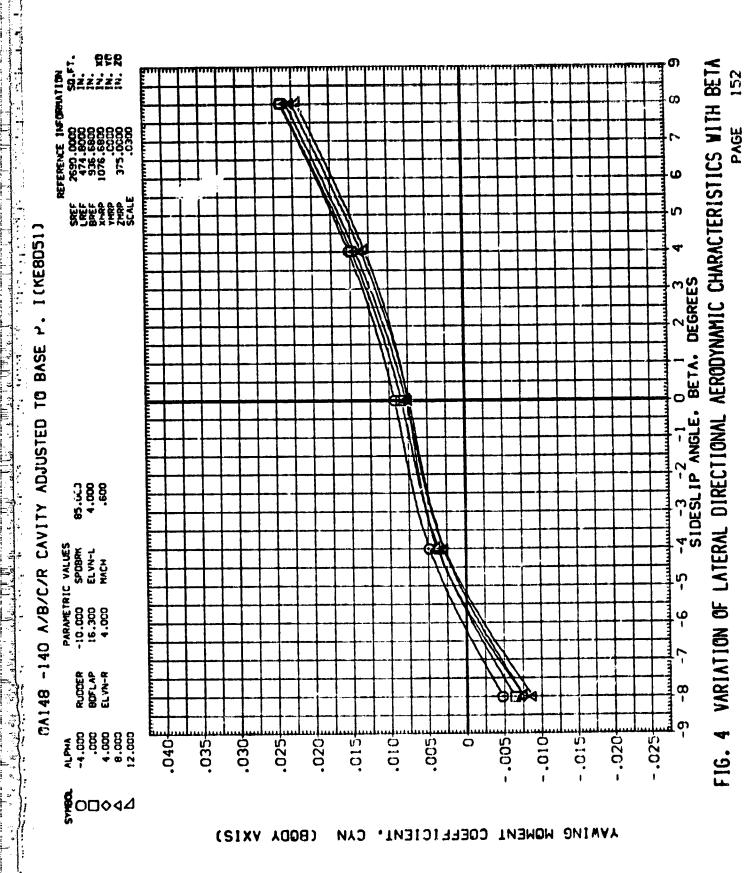
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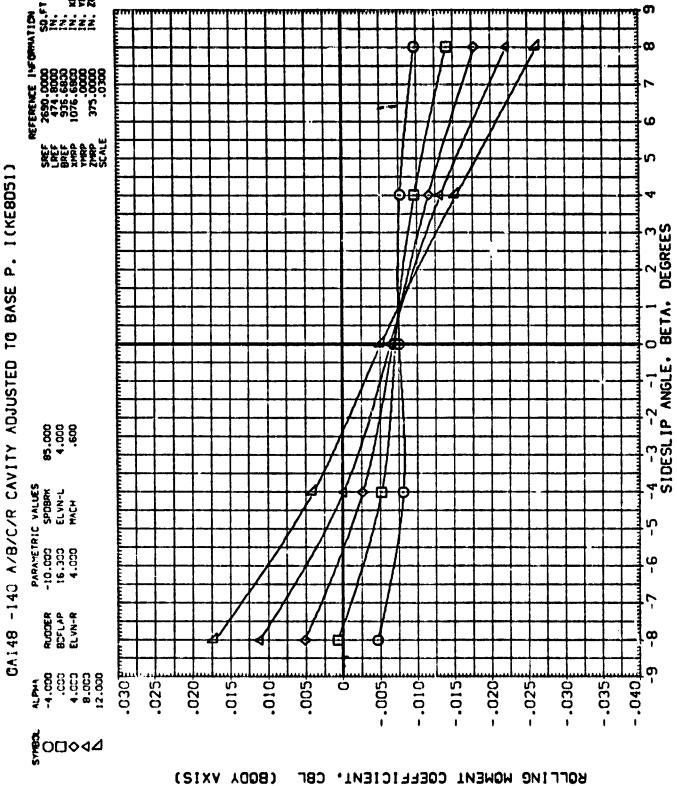
10 375,0000 IN. XI VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 150 PAGE SREF LREF BREF XMRP YMRP ZMRP SCALE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I(KE8D50) -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES 85.000.4 000.9 000.000.000.000 PARAMETRIC VALUES
-10.000 SPDBPM
16.300 ELVN-L
4.000 MACH RUDDER BOFLAP ELVN-R ALPHA -4.000 4.000 8.000 12.000 **通010** -.018<u>E</u> F16. 4 #800° -00e - .002春 -.004분 <del>1</del>900∙-- .008<del>[</del> -.014 <del>-</del>910 -.004<del></del> -.010 .002 -.0:2 Ö (BIXY ADDB) CBF ROLLING MOMENT COEFFICIENT.



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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE



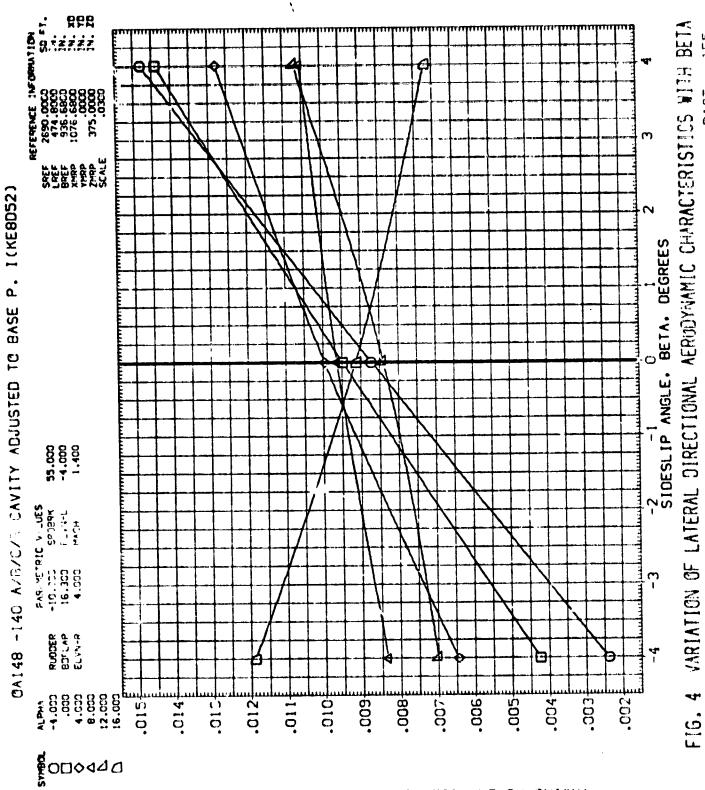


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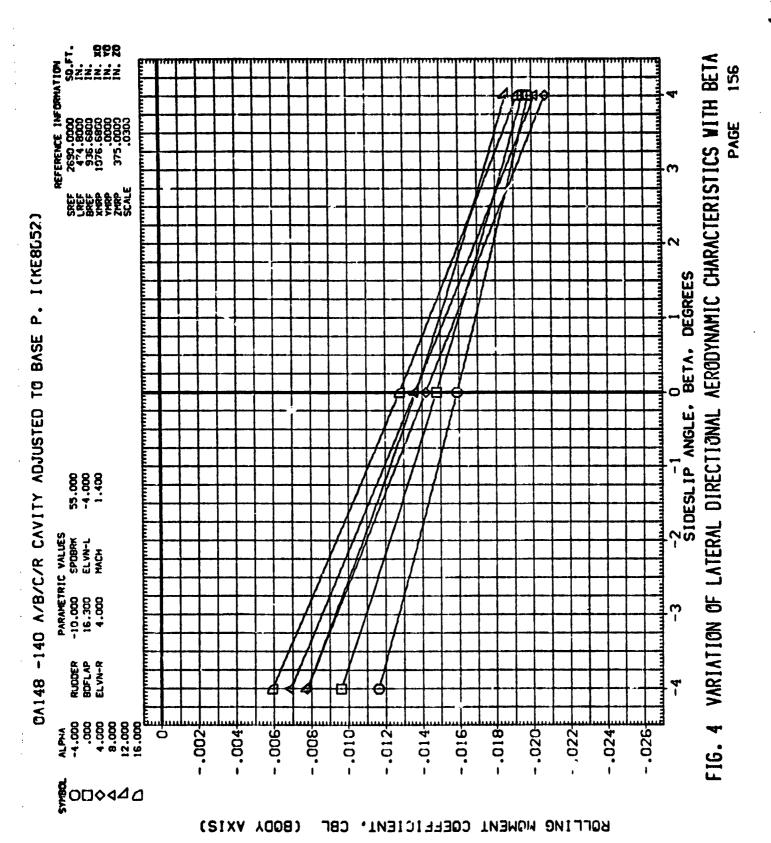
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE

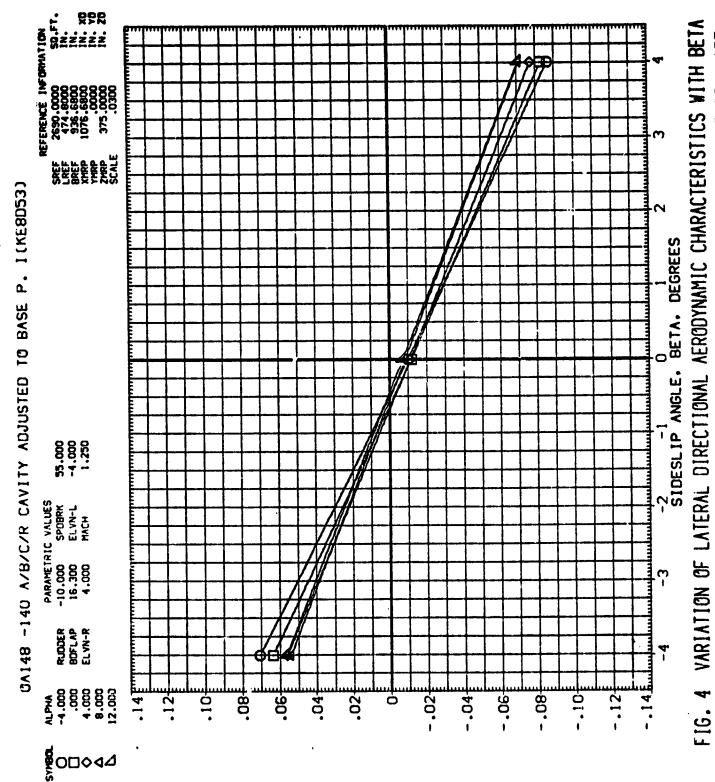
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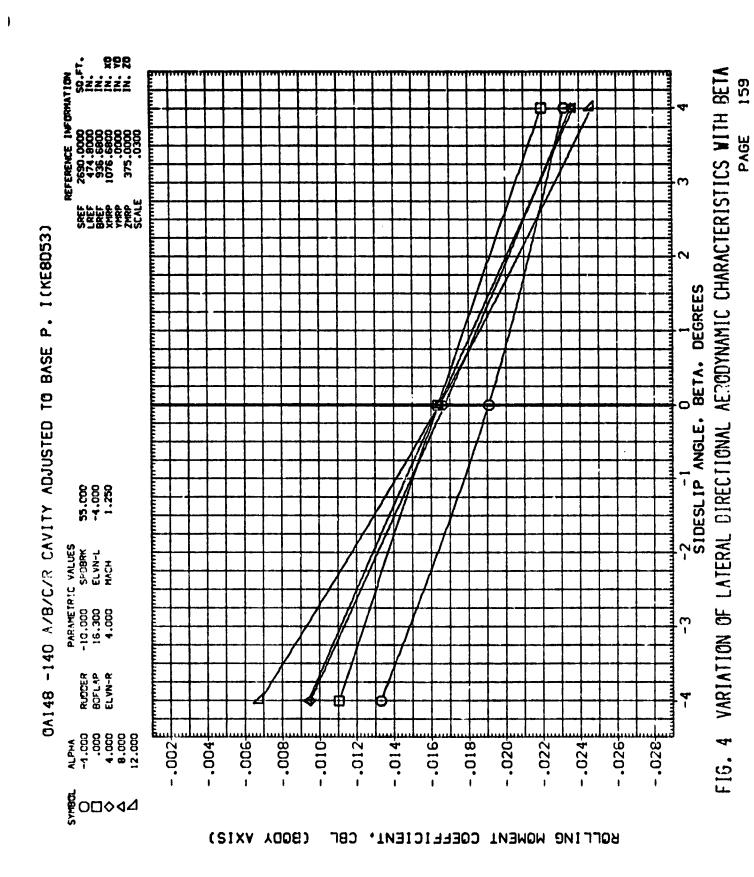


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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE SIDESLIP ANGLE, BETA, DEGREES

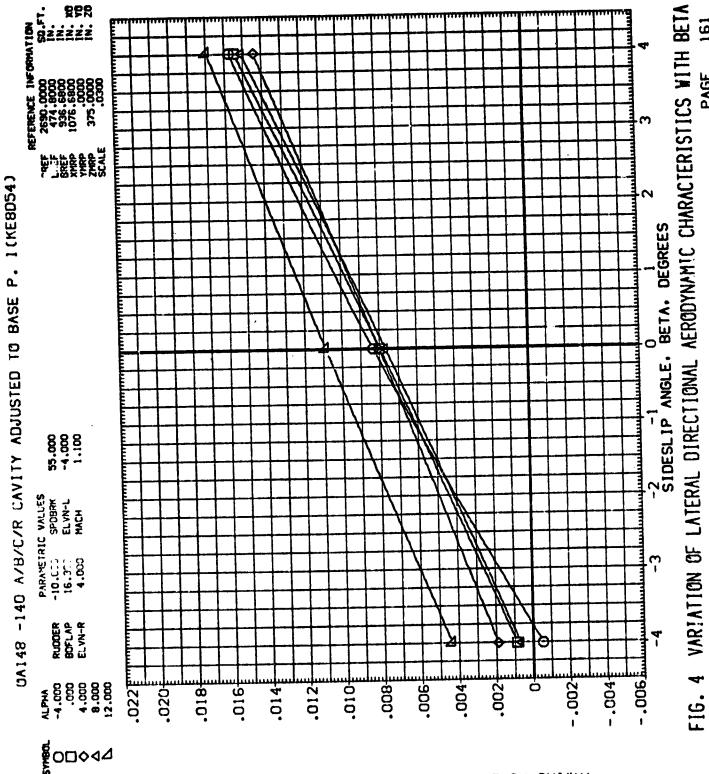
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 160

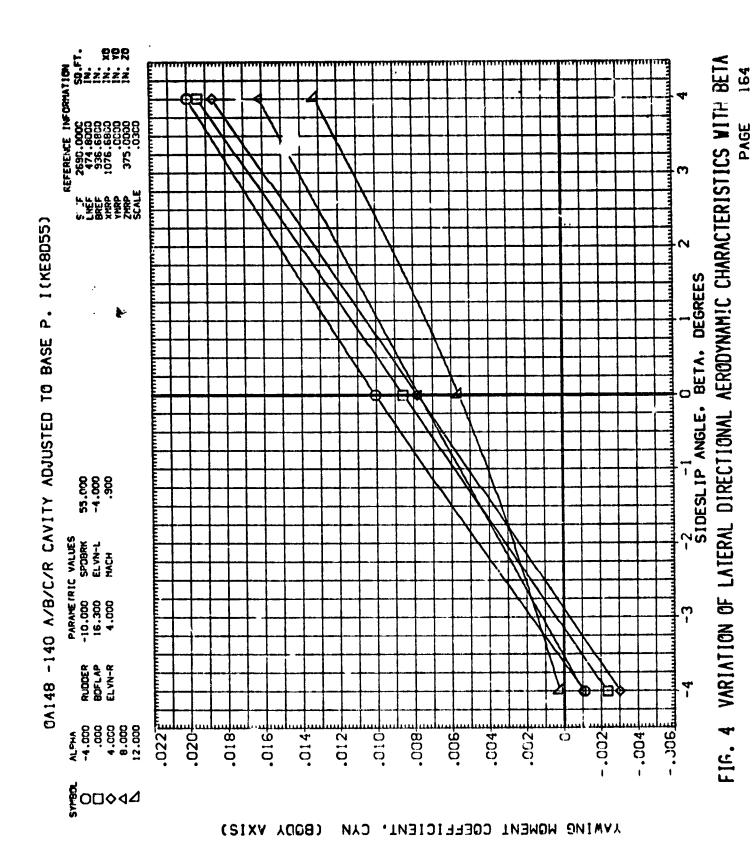


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VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA -2 -1 0 1 SIDESLIP ANGLE, BETA, DEGREES FIG. 4

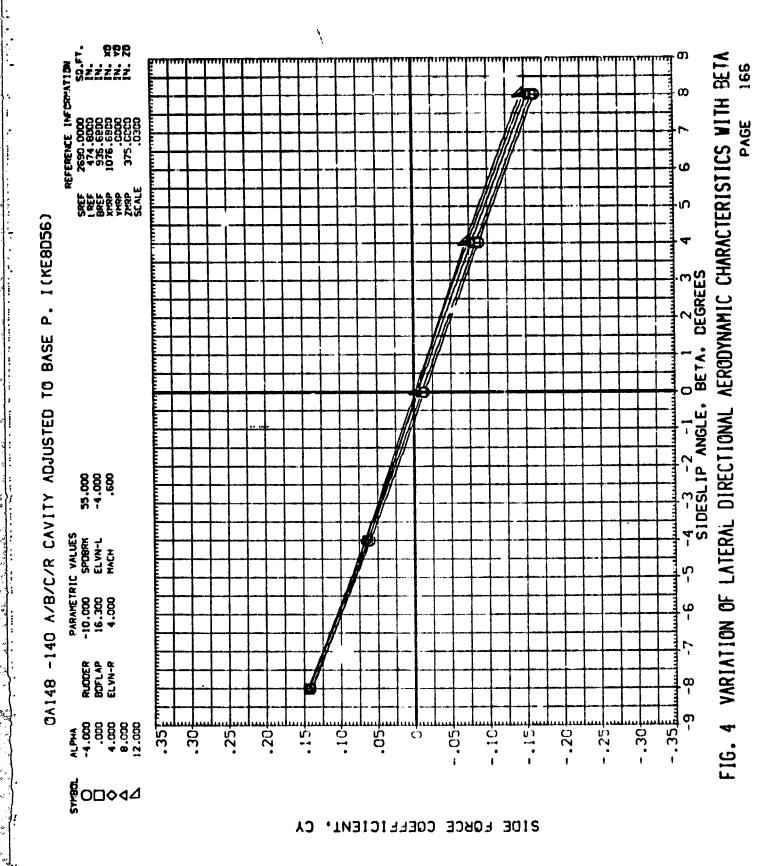
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



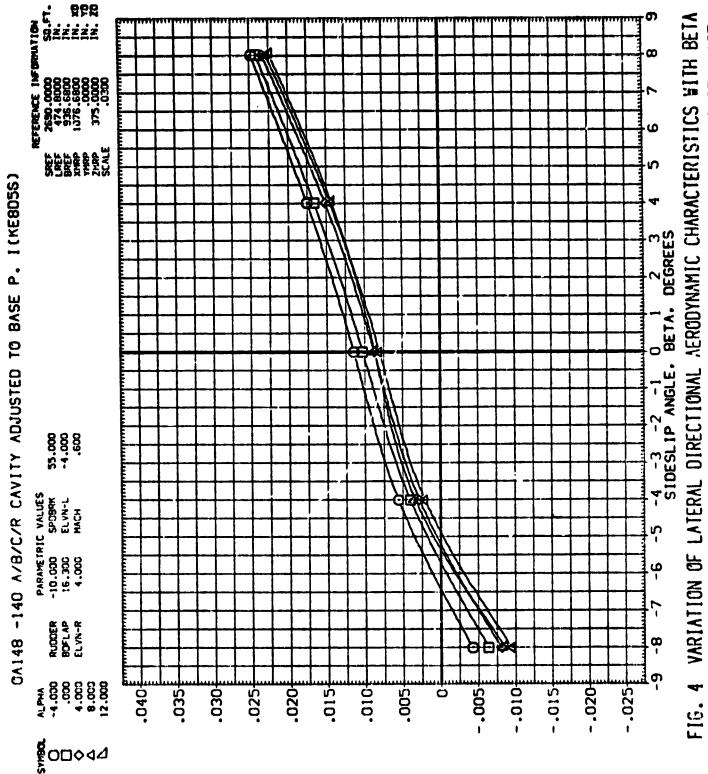
SZZZZZ E RPR VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 165 AFERENCE 1NF 2890.0000 474.8000 1076.6800 175.0000 375.0000 PAGE SCALE SCALE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. 1:KE8D553 -2 1 0 1 SIDESLIP ANGLE, BETA, DEGREES 55.000 -4.000 .900 PARAMETRIC VALUES
-10.000 SPOBRK
16.300 ELVN-L
4.000 MACH RUDDER BOFLAP ELVN-R F16. 4 4.000 4.000 6.000 12.000 -.016<del>]</del> -.030 -.024 -.026 -.028 -.008<del>[</del> -.012 -.018 -.032 -.006 -.010--.014 -.020 -.022 **§**O□◊4△ ROLLING MOMENT COEFFICIENT. (SIXV ADDB) CBF

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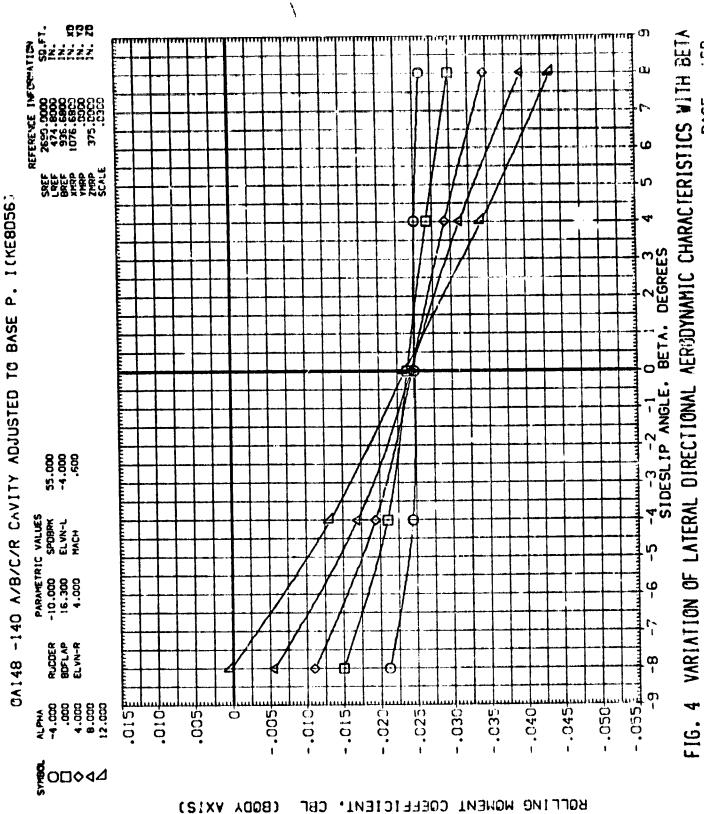


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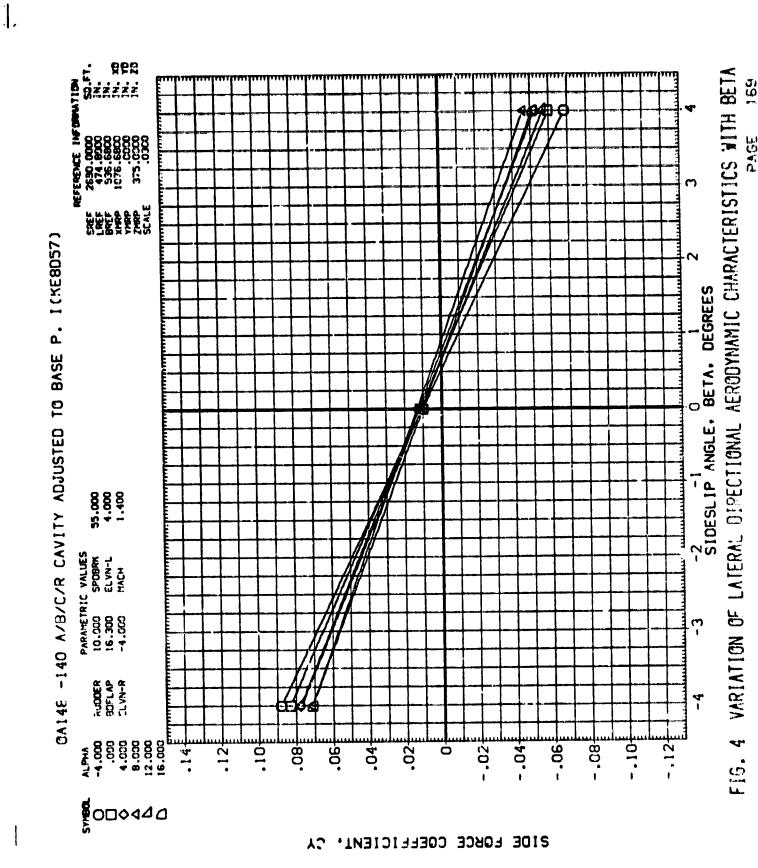
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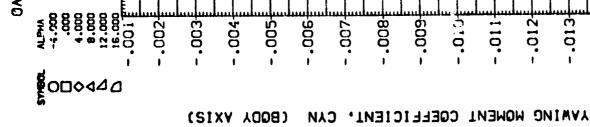
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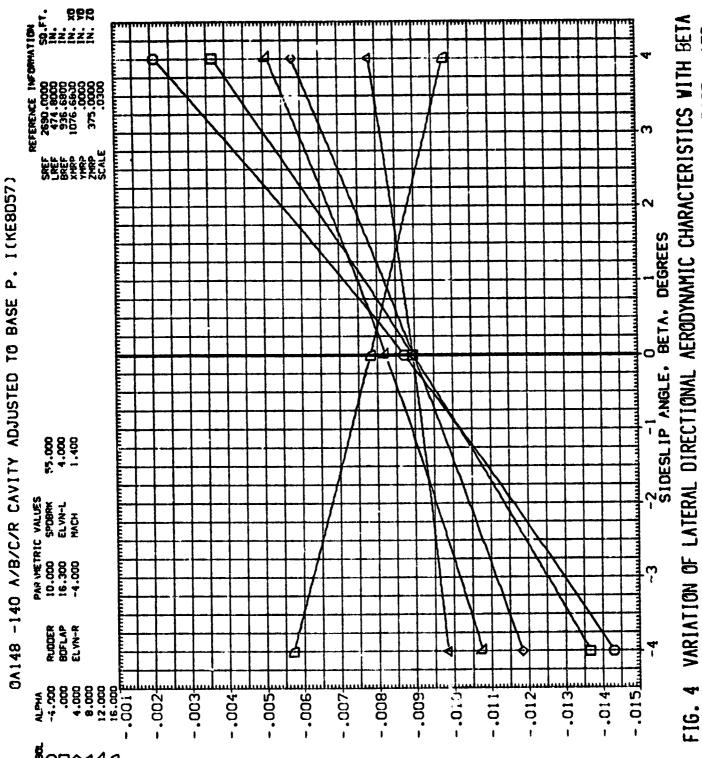
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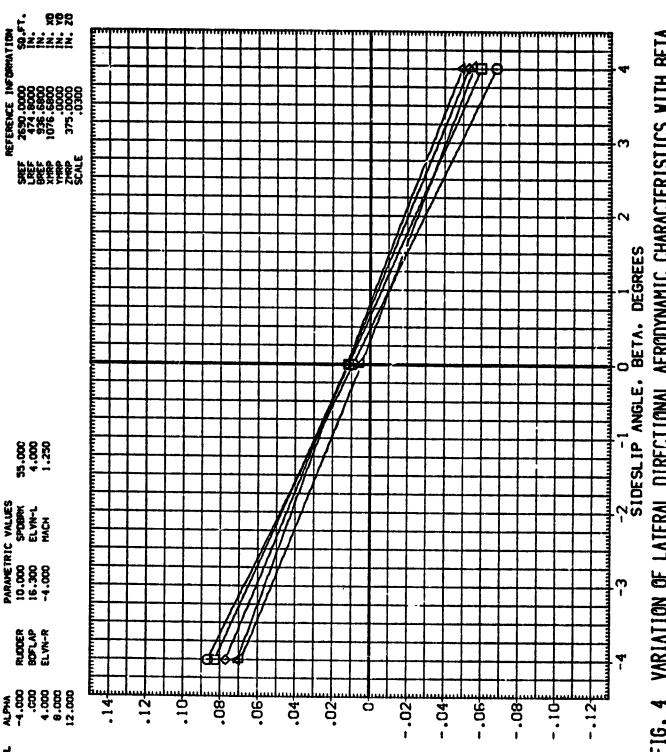


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775.0000 IN. 70 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA SREF LREF BREF XHRP XHRP SCALE GA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I (KEBD57) -2 1 0 1 SIDESLIP ANGLE, BETA, DEGREES 55.000 4.000 1.400 PARAMETRIC VALUES 10.000 SPOBRK 16.300 ELVN-L -4.000 MACH က RUDDER BOFLAP ELVN-R 4.000 4.000 12.000 15.000 -020年 表200. .018£ .016<del>[</del> .012<del>{</del> .010<del>-</del> .026 .024 .022ŧ .014 **3800** 900 .004 

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

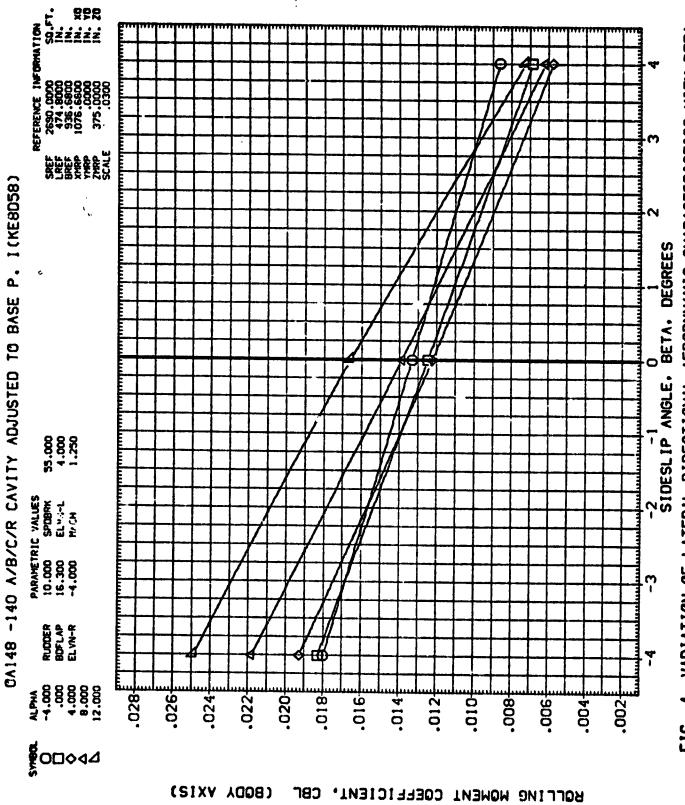
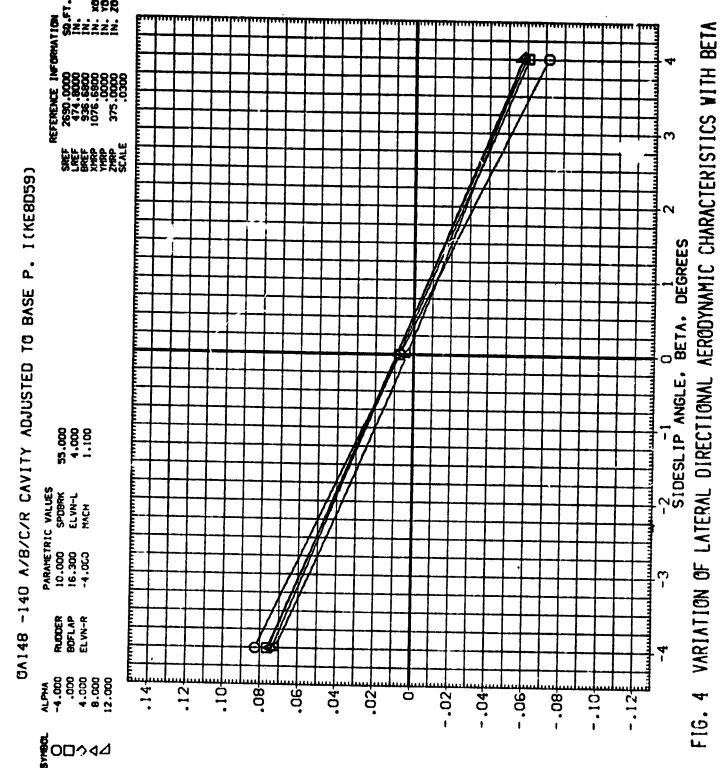


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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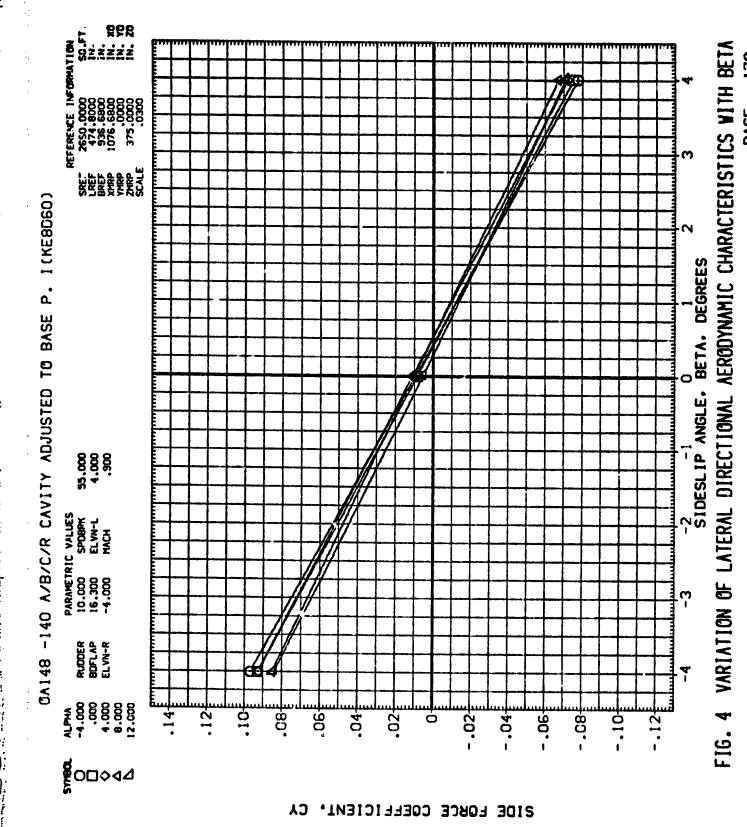
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2690.0000 474.8000 936.8800 1076.6800 375.0000 SREF LREF BREF ZYRP SCALE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I (KE8D59) SIDESLIP ANGLE, BETA, DEGREES 55.000 4.000 1.100 PARAMETRIC VALUES 10.000 SPOBRK 16.300 ELVN-L -4.000 MACH <u>۾</u> RUDOER BOFLAP ELVN-R 子900. -008 -AL 000 4.000 4.000 8.000 12.000 .014 .032臣 .018<del>[</del> .016<del>[</del> .012<del>{</del> -010<del>-</del> ₹080° .022 .020 .028 .026 .024 **№**0□◊4△ ROLLING MOMENT COEFFICIENT, CBL

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 39**V**c



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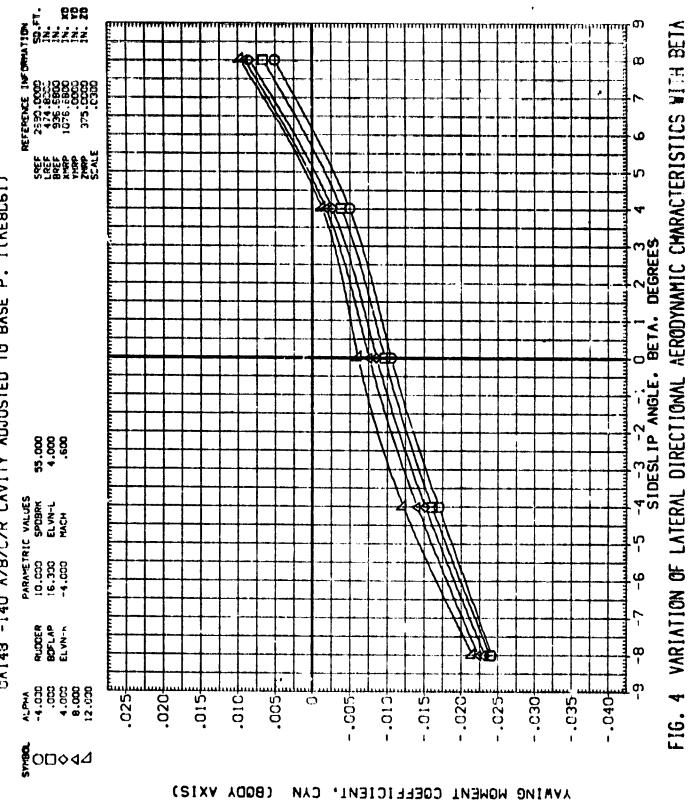
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 180 PAGE

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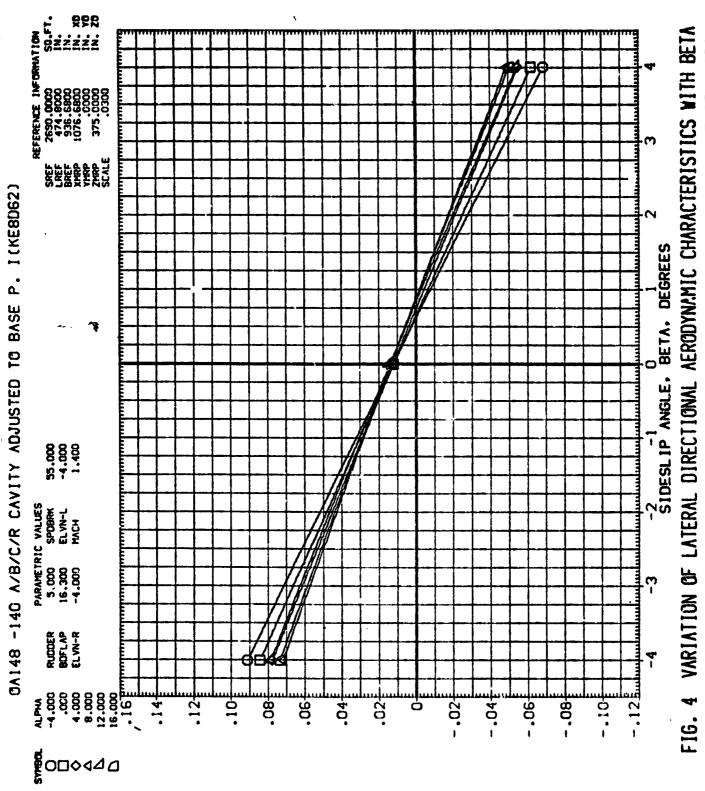
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



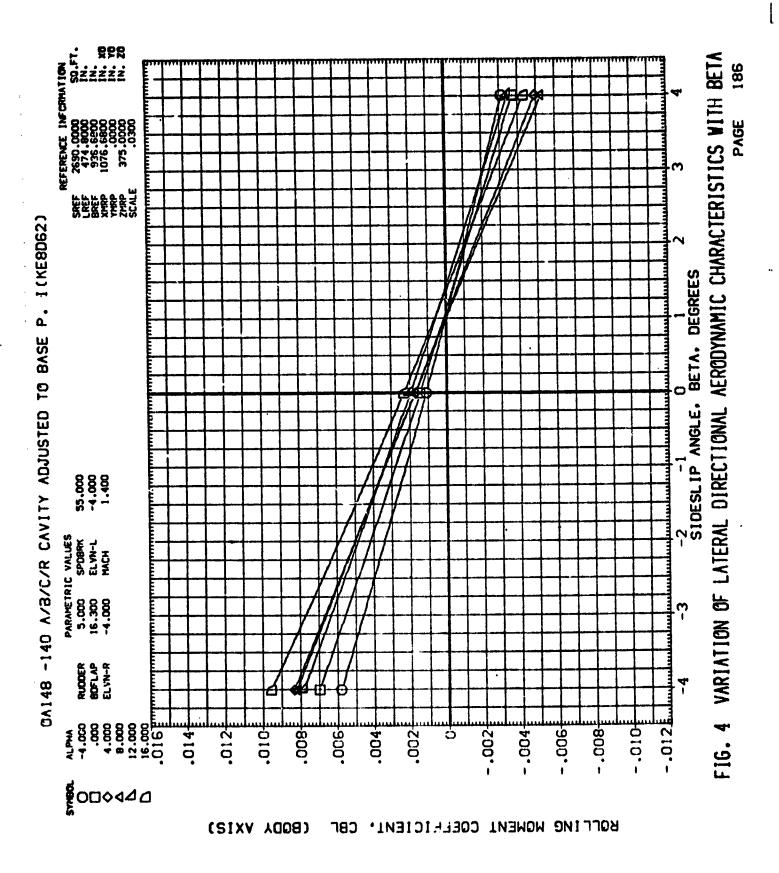
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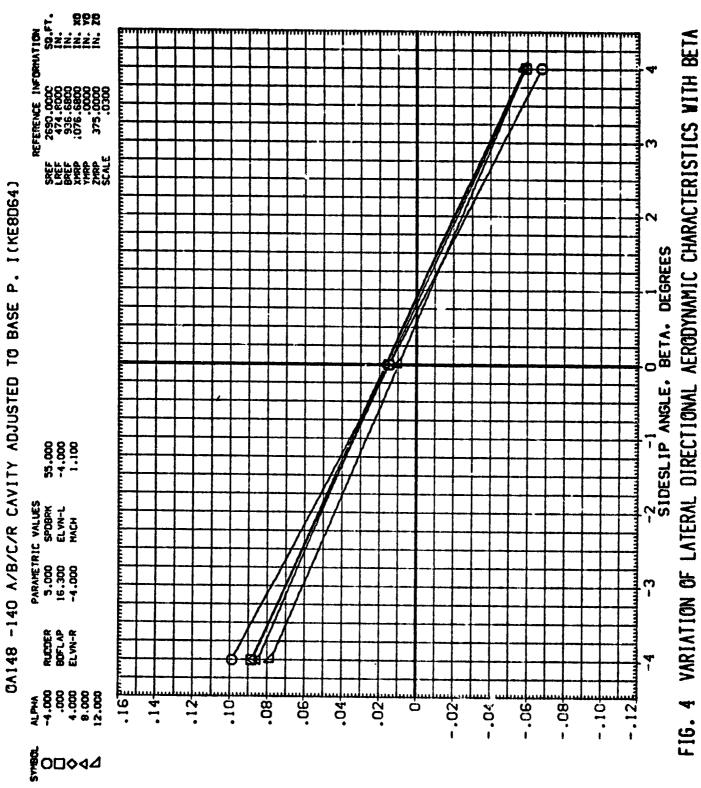


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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

SZZZZZ G65 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 2630.0000 474.9000 938.6800 1076.6800 375.0000 375.0000 PAGE STARP STARP SCALE 0A148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I(KE8D63) SIDESLIP ANGLE, BETA, DEGREES 55.000 -4.000 1.250 PARAMETRIC VALUES 5.000 SPOBRK 16.300 ELVN-L -4.000 MACH RUDDER BOFLAP ELVN-R -.010<u>ह</u> ALPIA -4.000 4.000 8.000 12.000 .018世 -016F -.004 -.006<del>-</del> -.008 ₹800° .006<del>-</del> .004 -.002 -010<del>-</del> .002 .014 -012 Ö **№**0□**◊**4△ ROLLING MOMENT COEFFICIENT. (SIXV ADDB) CBF



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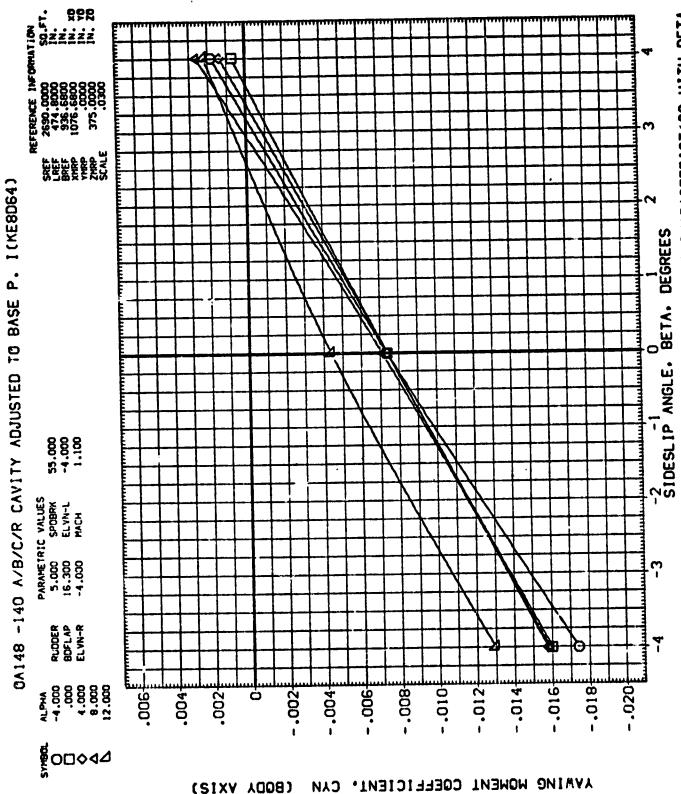
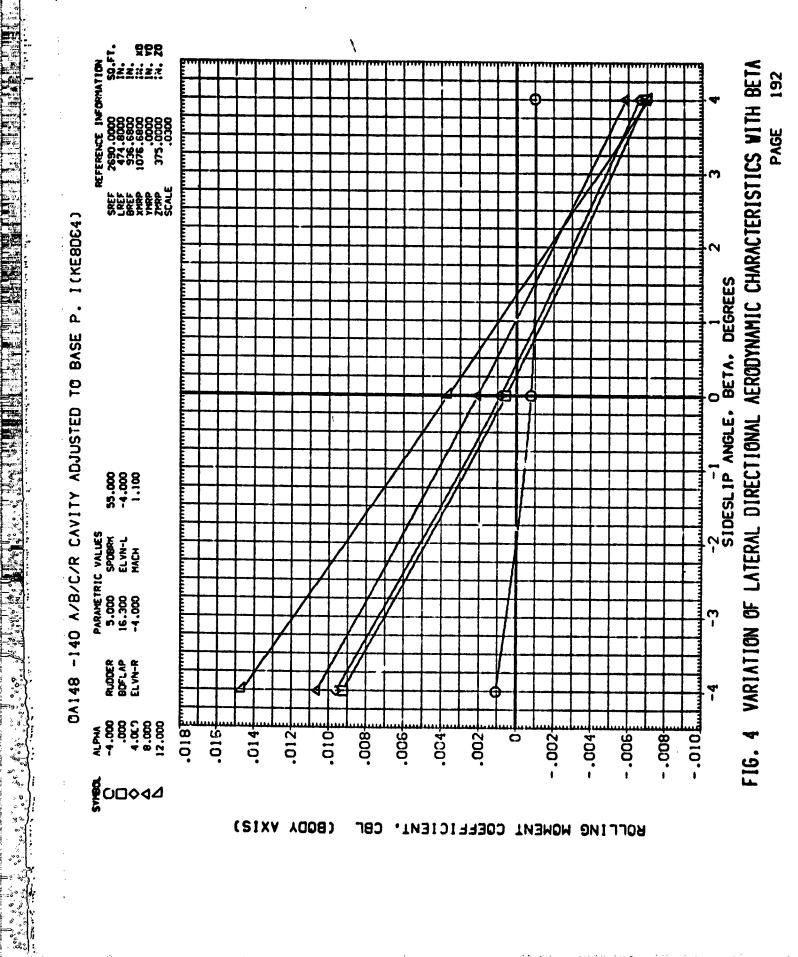
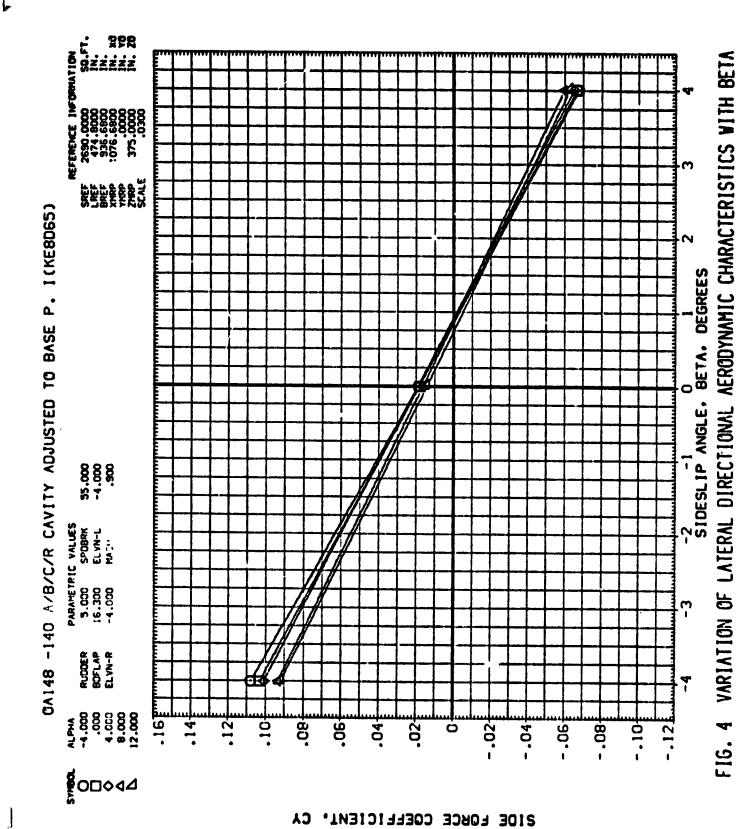


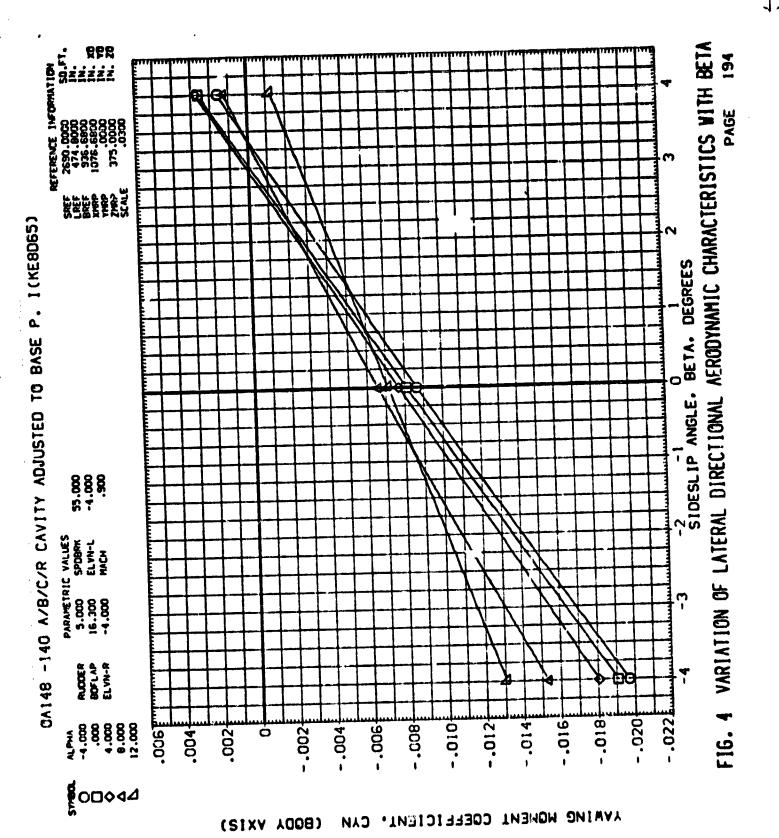
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AFRODYNAMIC CHARACTERISTICS WITH BETA 191



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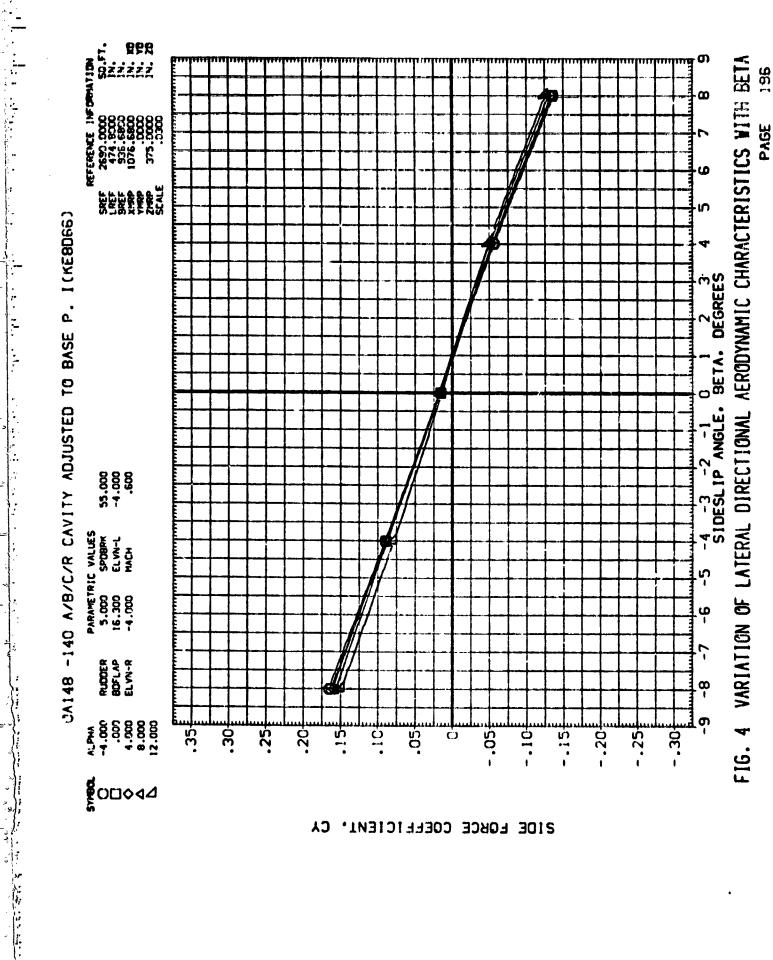
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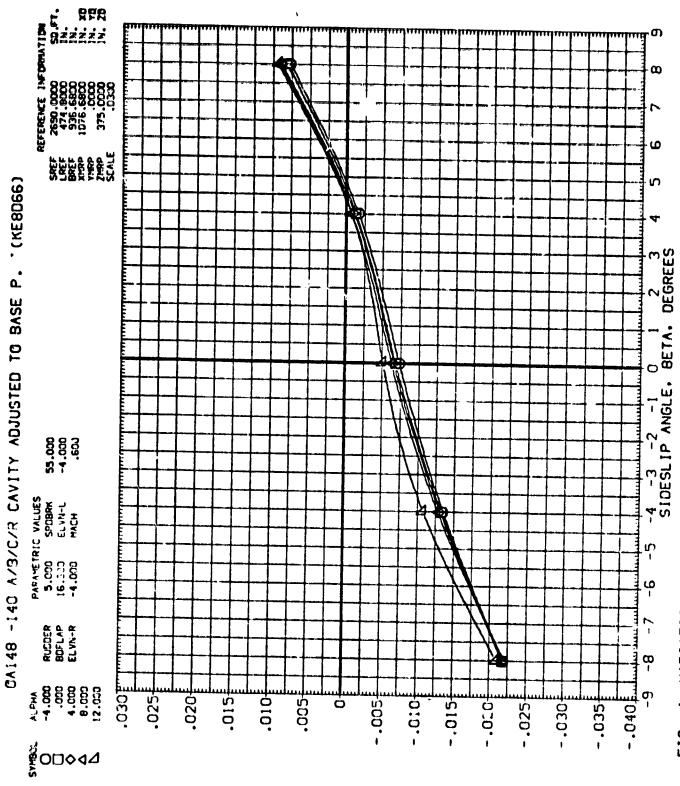
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 195





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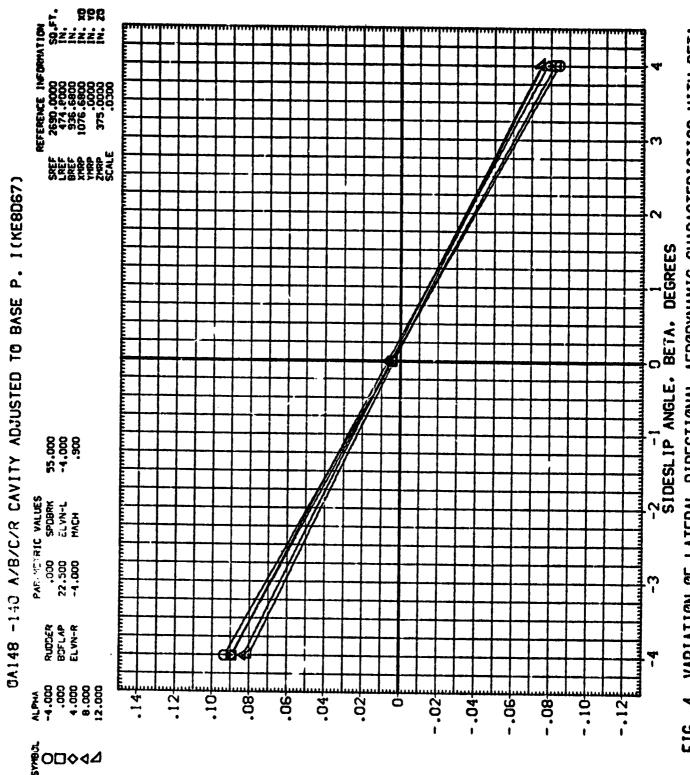
YAWING MOMENT COEFFICIENT, CYN (SIXY ADD8)

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VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE F16. 4

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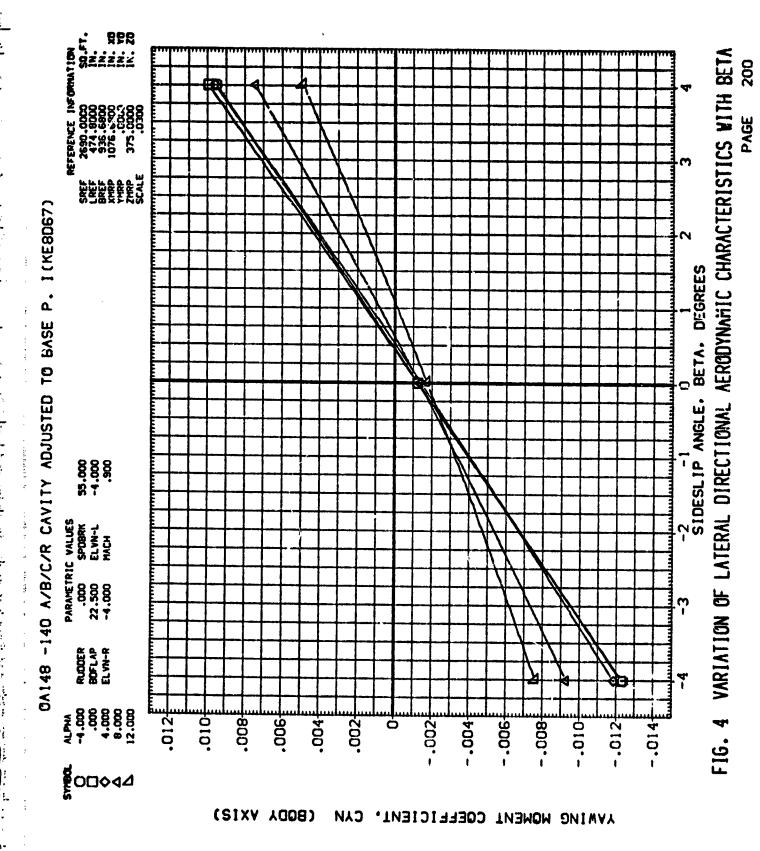
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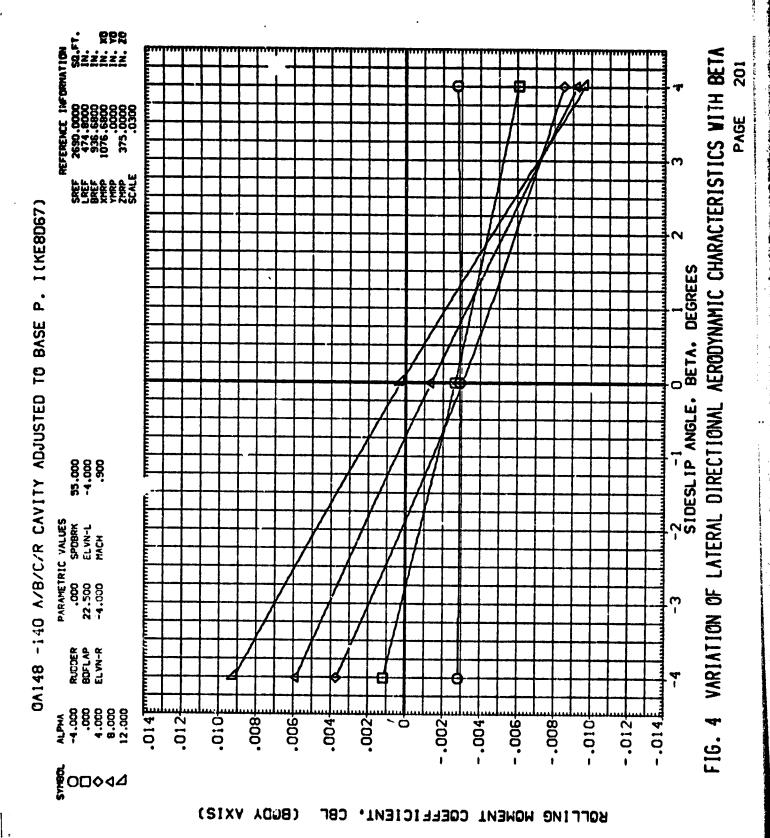
SIDE FORCE COEFFICIENT,

FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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REFERENCE INFORMATION \$0.FT. 2559.0000 \$0.FT. 474.8000 IN. 535.6800 IN. 20 1075.6800 IN. 20 375.0000 IN. 20 10. 20 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA SREF LREF BREF XHRP YHRP SCALE CA148 -140 A/B/C/R CAVITY ADJUSTED TO BASE P. I (KE8D68) -4 -3 -2 -1 0 1 2 3 SIDESLIP ANGLE, BETA, DEGREES 55.90 25.900 600.600 PARAMETRIC VALUES .000 SPOBRK 22.500 ELVN-L -4.000 MACH RUDDER BOFLAP ELVN-R .35E ALPHA -4.000 4.000 8.000 12.00 -.10長 30£ .20£ -.05 -.15 -.25 -.30 .25<u>£</u> .15 -.20 9: .05 Ö **E**O□◊44 SIDE FORCE COEFFICIENT.

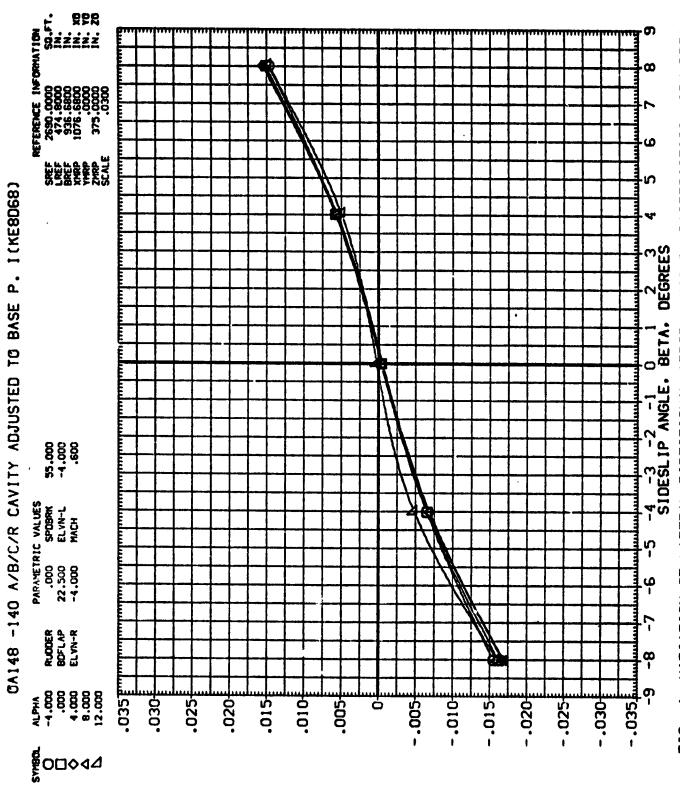


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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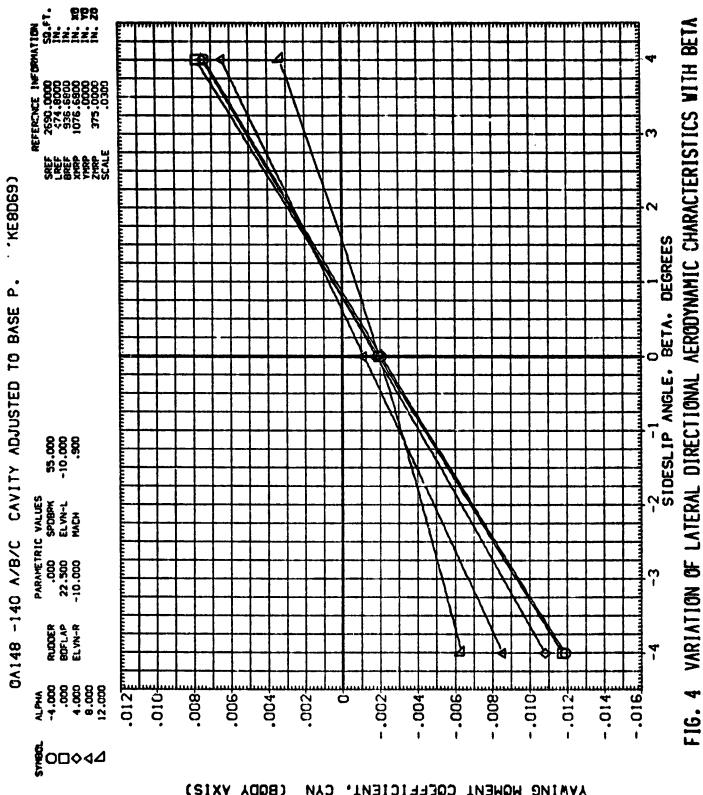
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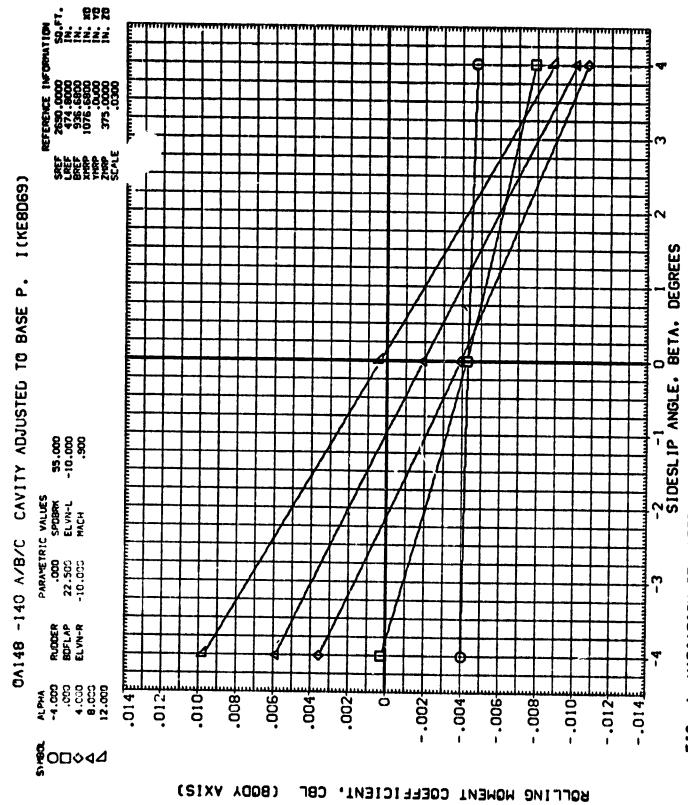
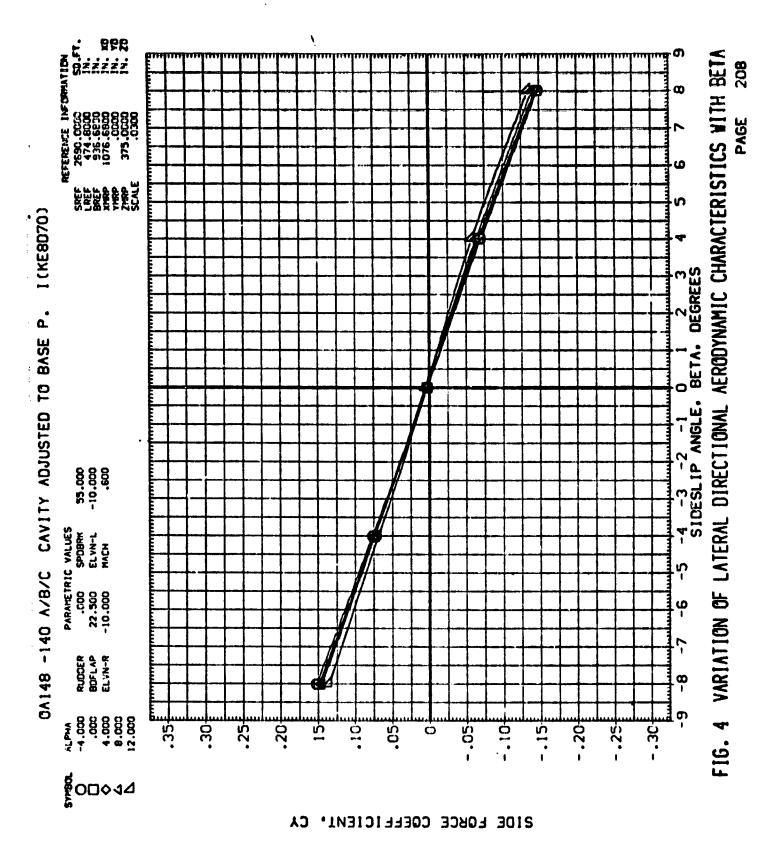


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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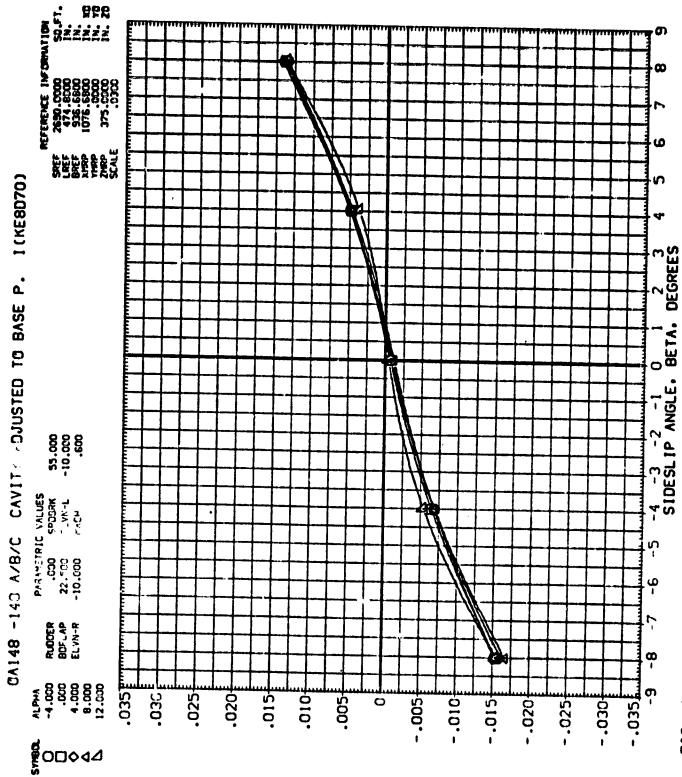


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACIERISTICS WITH BETA

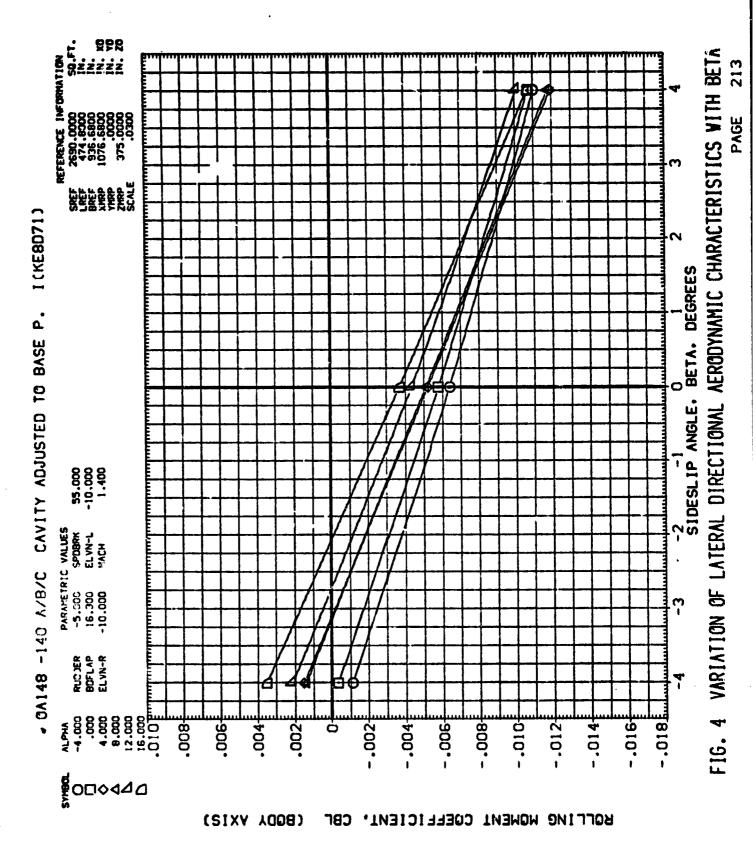
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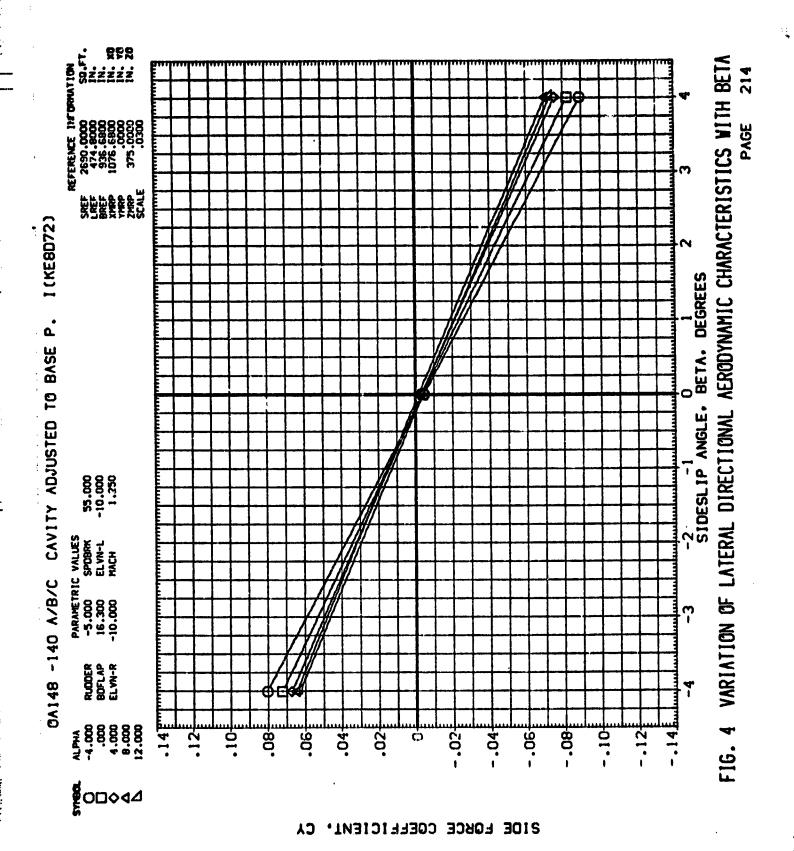
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE

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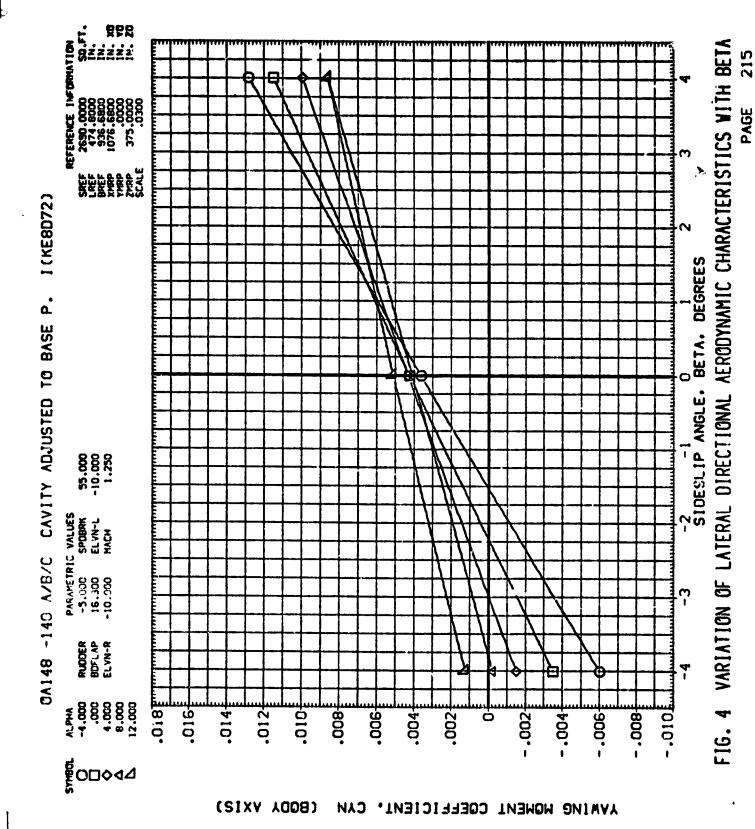
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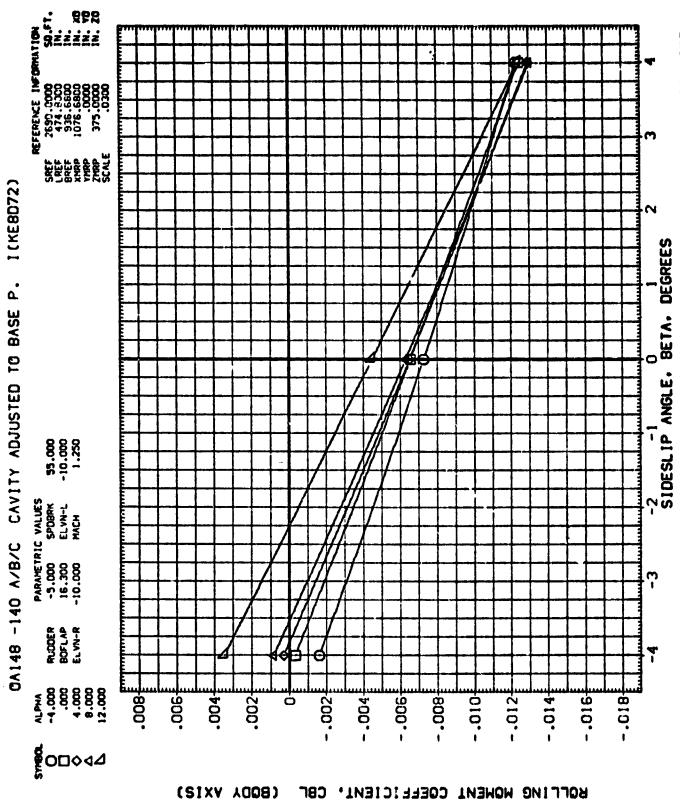
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VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA F16. 4

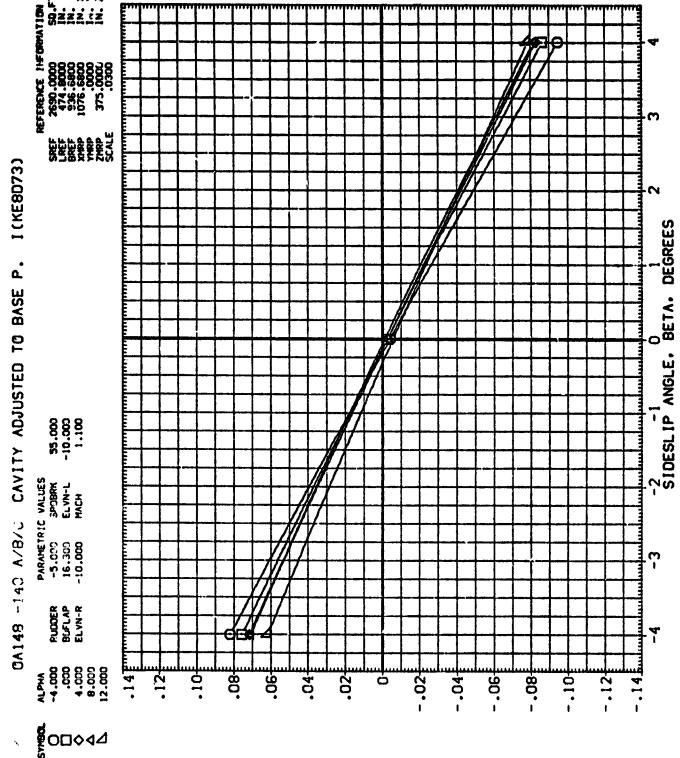


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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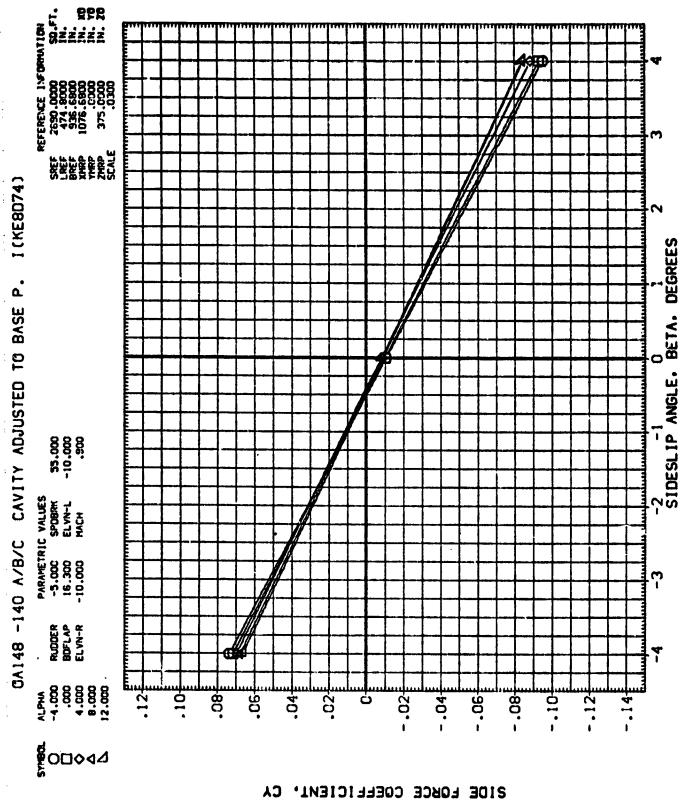
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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



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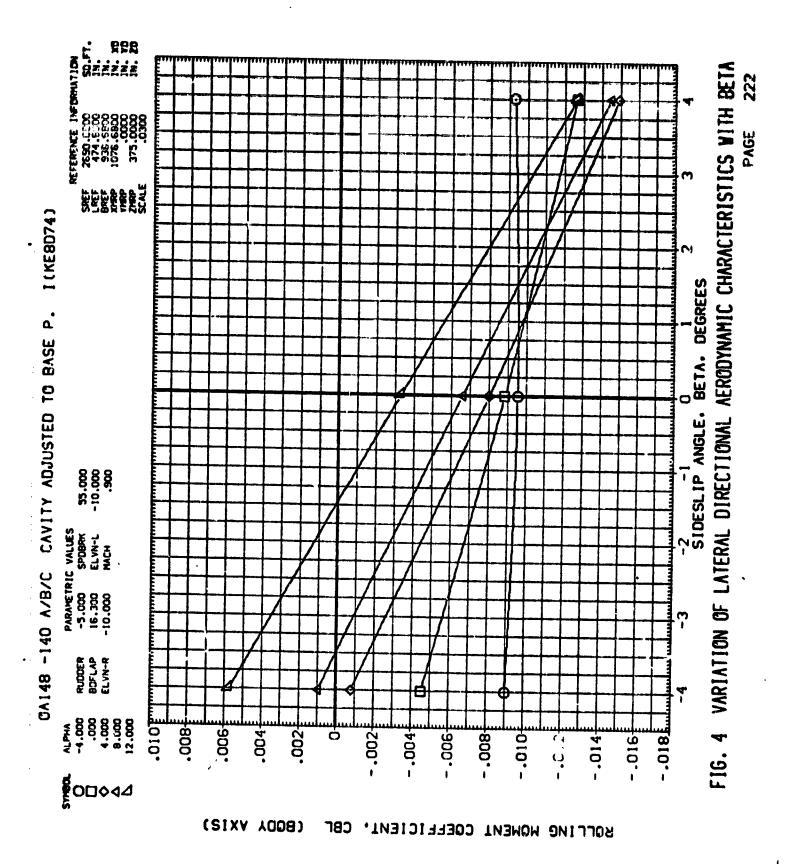
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

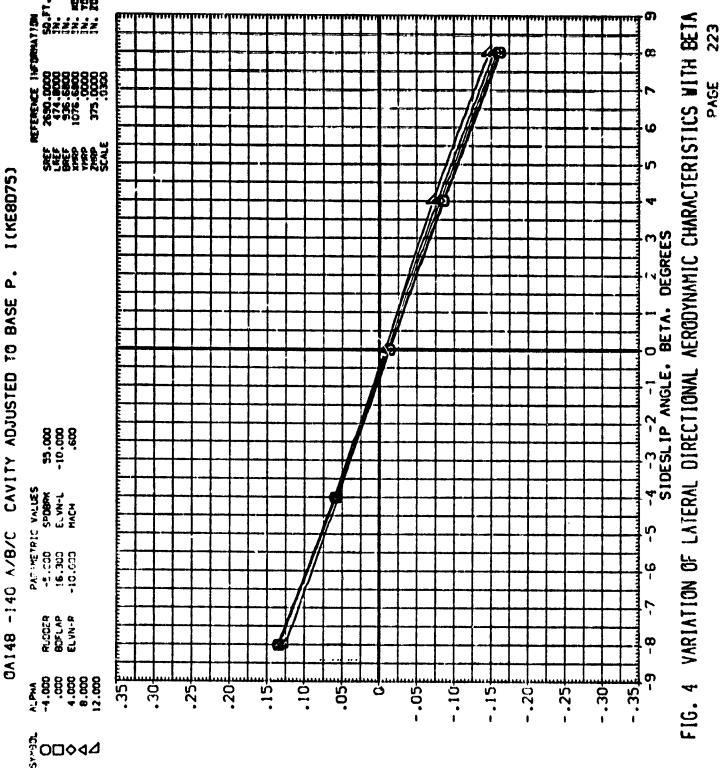
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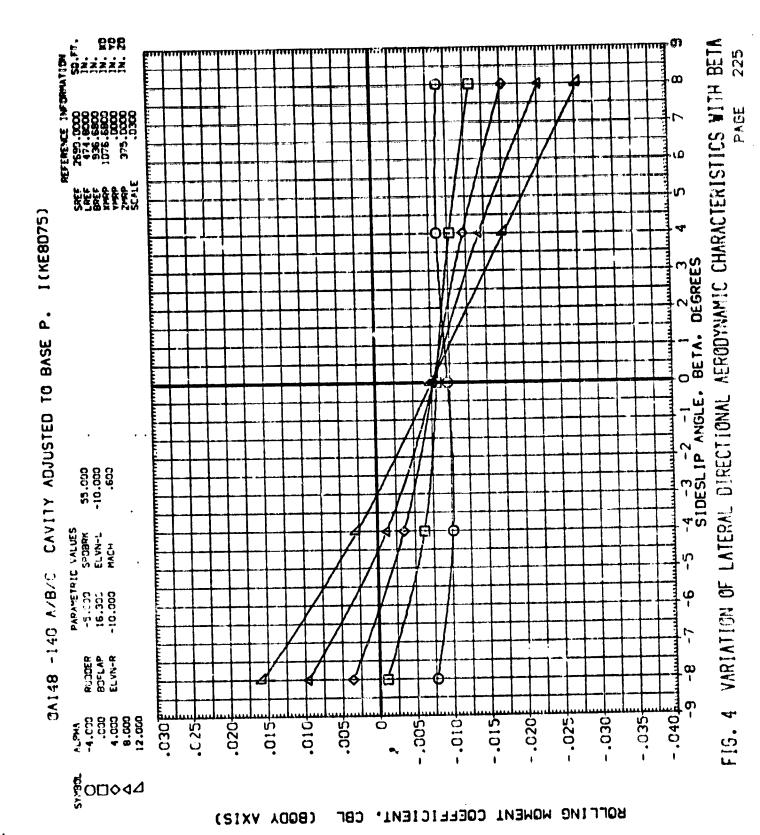
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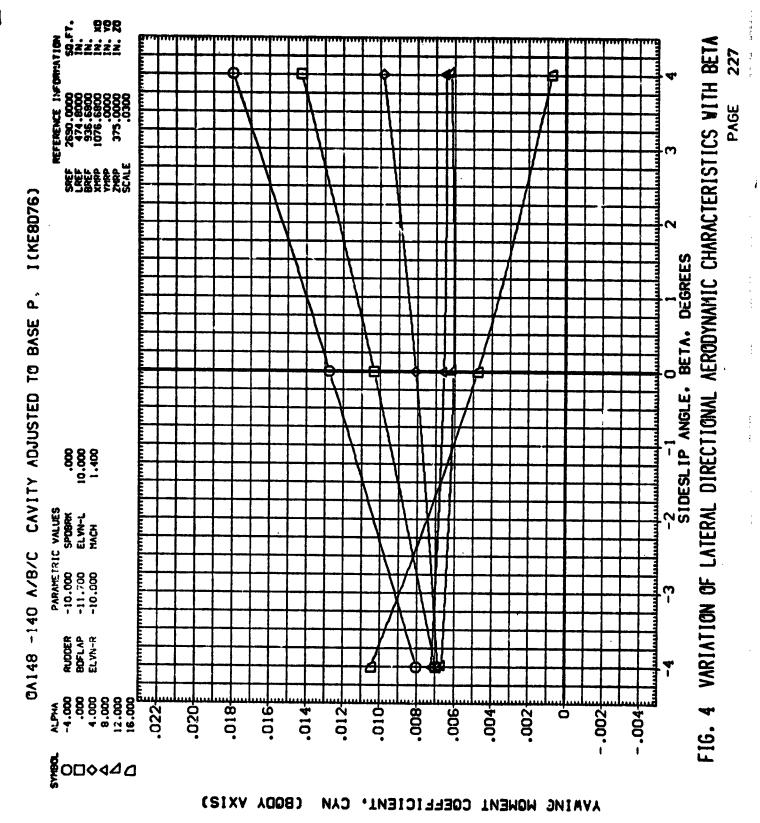
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA PAGE



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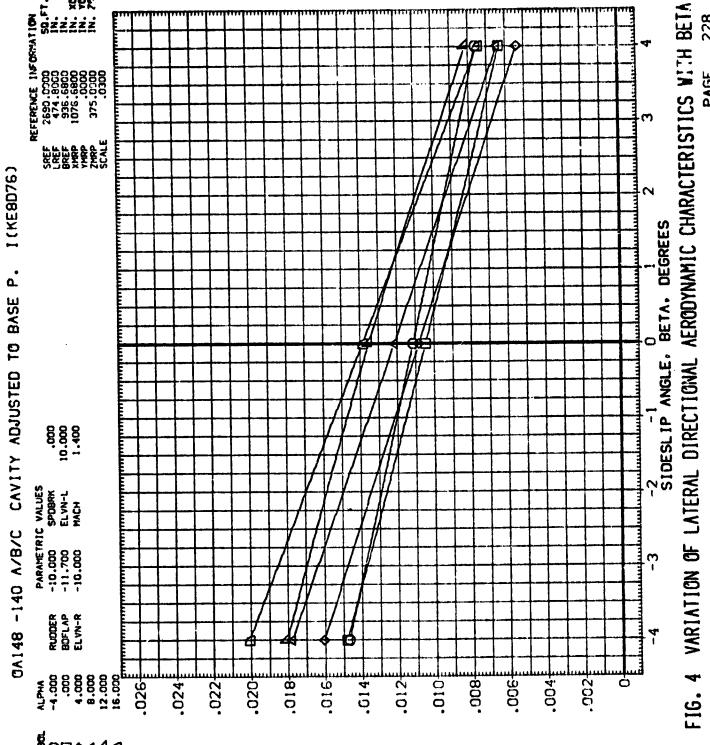
SIDE FORCE COEFFICIENT, CY

FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA



4.000 4.000 12.000 16.000 ₹900° -010등 .026 .024€ .022 .020<del>[</del> .018€ .016<u>+</u> .014<del></del> .012 <del>1</del>800• .004 ROLLING MOMENT COEFFICIENT, CBL

(BOOK VXIZ)



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9 375.0000 IN. 20 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 230 PAGE SREF LREF BREF XHRP ZHRP SCALE 1 (KE8077) SIDESLIP ANGLE, BETA, DEGREES GA148 -140 A/B/C CAVITY ADJUSTED TO BASE P. 0.000 PARAMETRIC VALUES
-10.000 SPOBRK
-11.700 ELVN-L
-10.000 HACH 7 RUDDER BOFLAP ELVN-R .002記 ALPHA -4.000 4.000 8.000 12.000 .030E -018年 -016 **最10.** .008<u>f</u> 1900 .004 .024春 .014년 -012<del>-</del> -026€ .028 .022<del>{</del> .020 AVMING MOMENT COEFFICIENT, CYN

(BODA VXIZ)

ROLLING MOMENT COEFFICIENT, CBL (BODY AXIS)

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA SIDESLIP ANGLE, BETA DEGREES

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YAWING MOMENT COEFFICIENT, CYN

(SIXV ADDB)

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FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 233

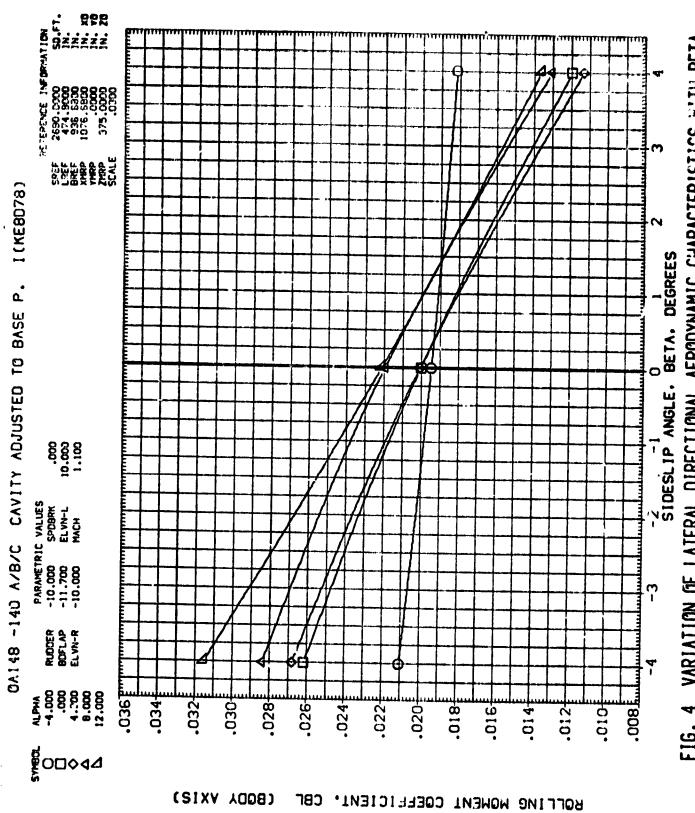


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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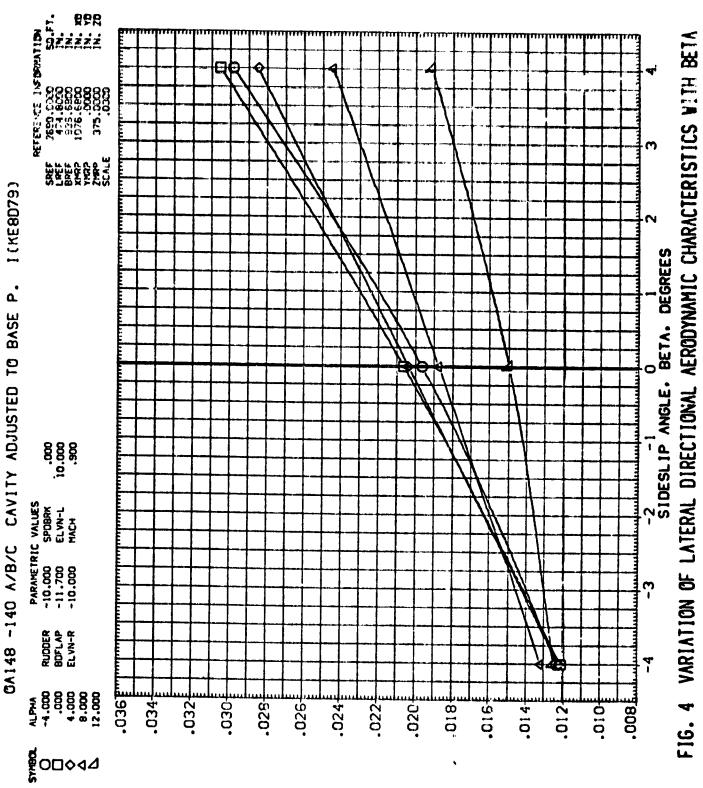
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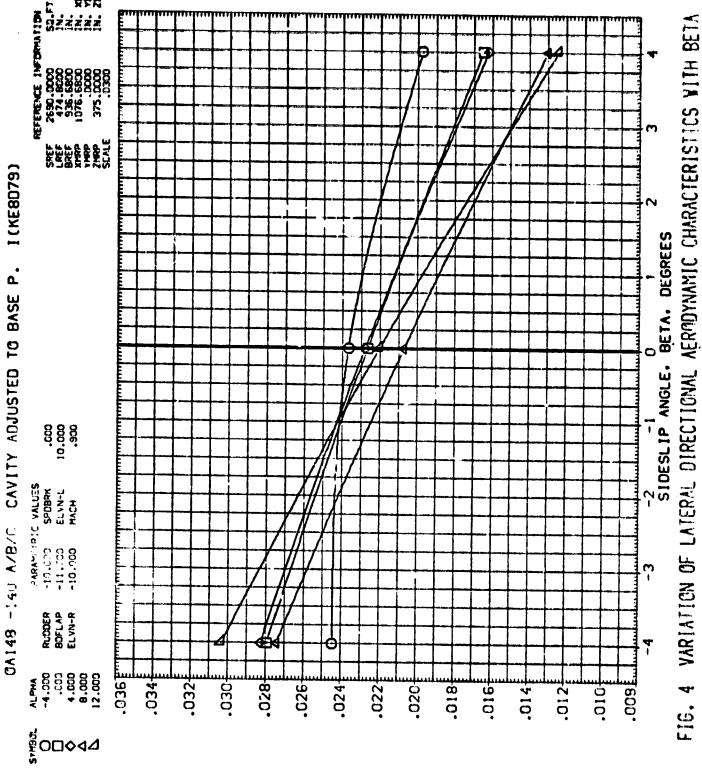
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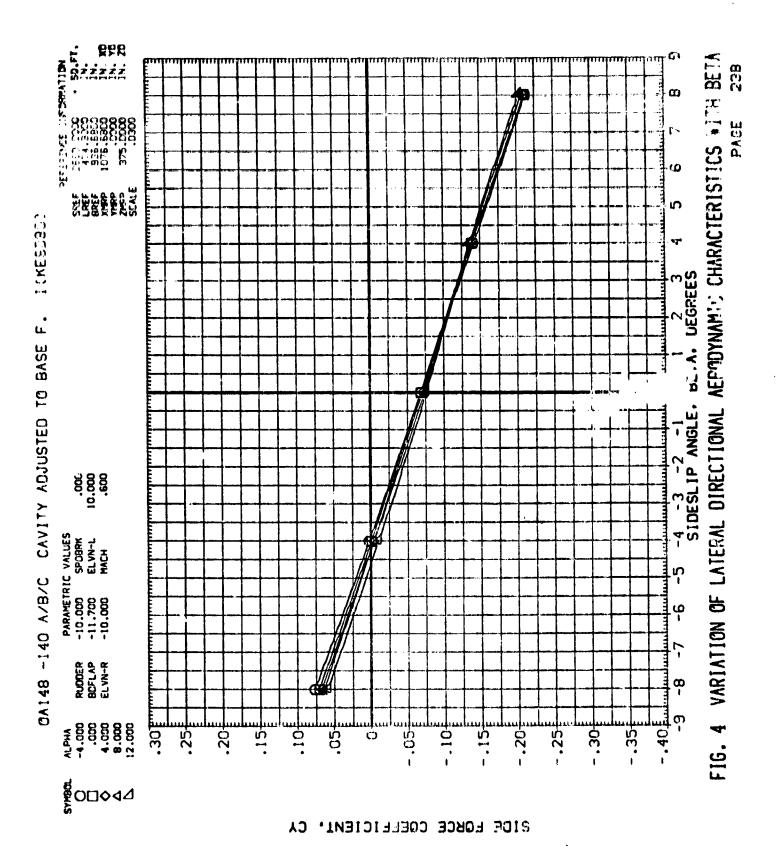
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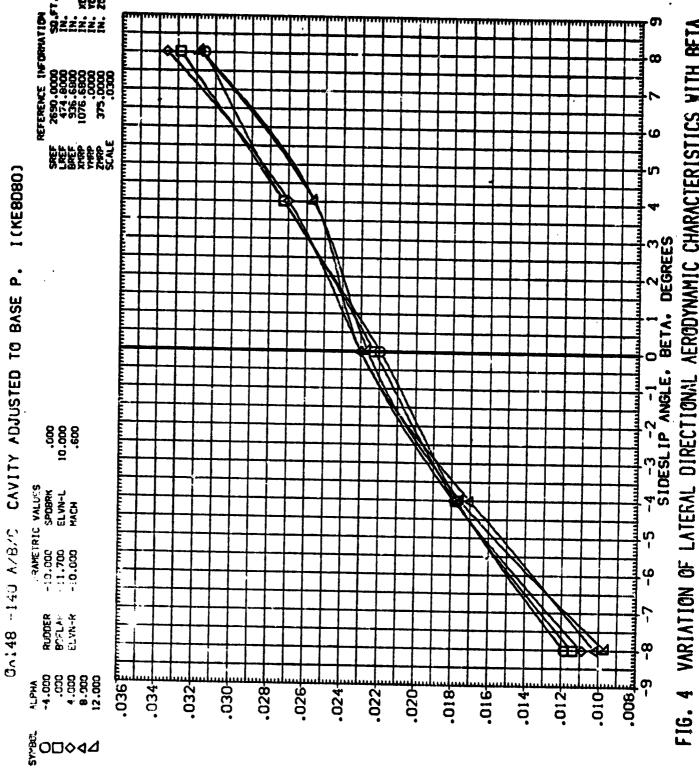
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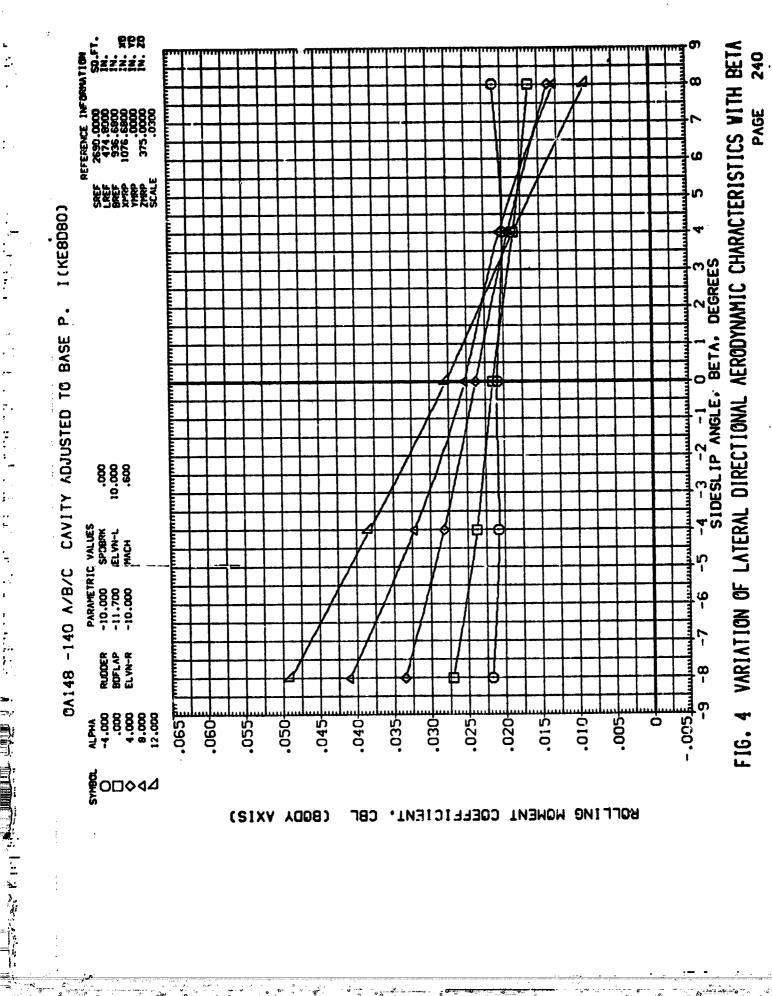


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(SIXY ADD8)

VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA

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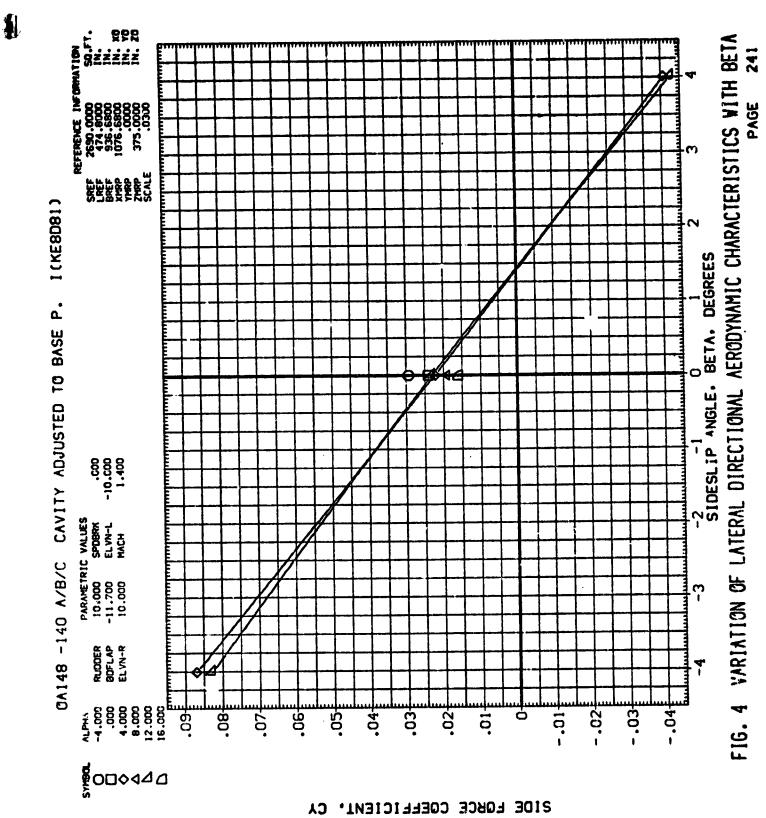
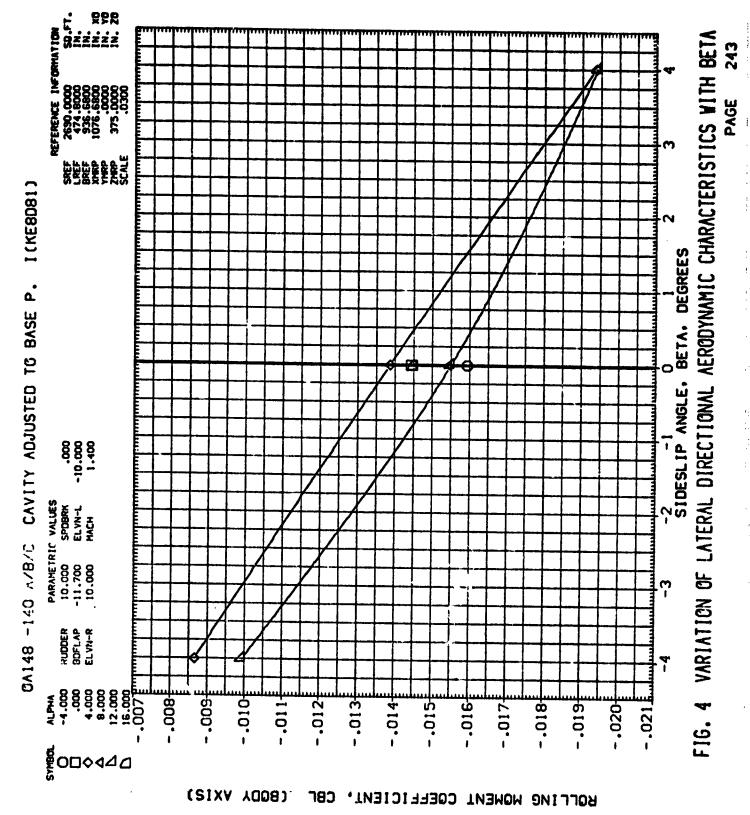
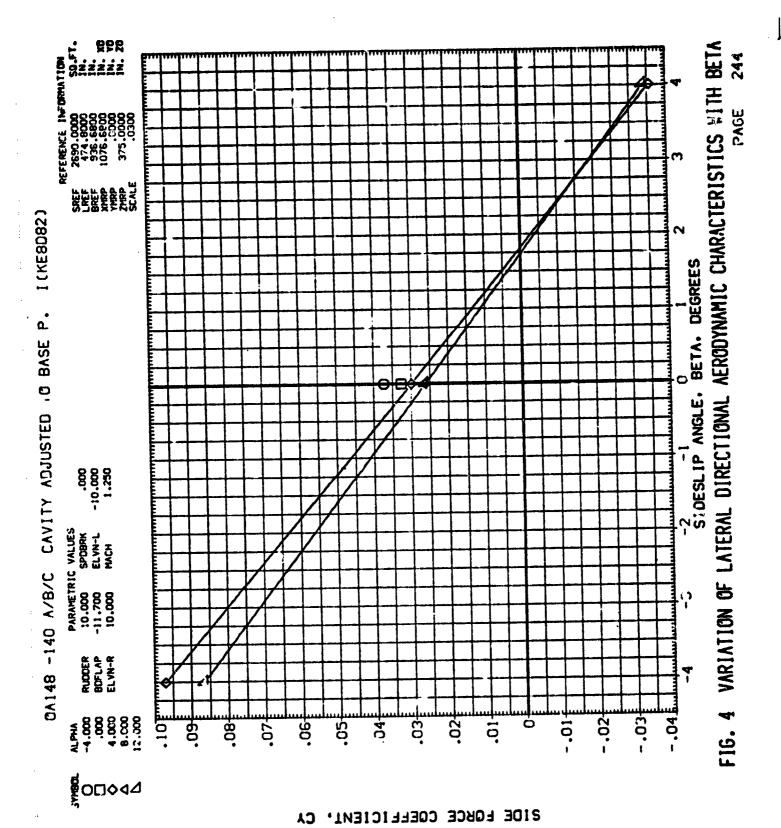


FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 242 SIDESLIP ANGLE, BETA, DEGREES

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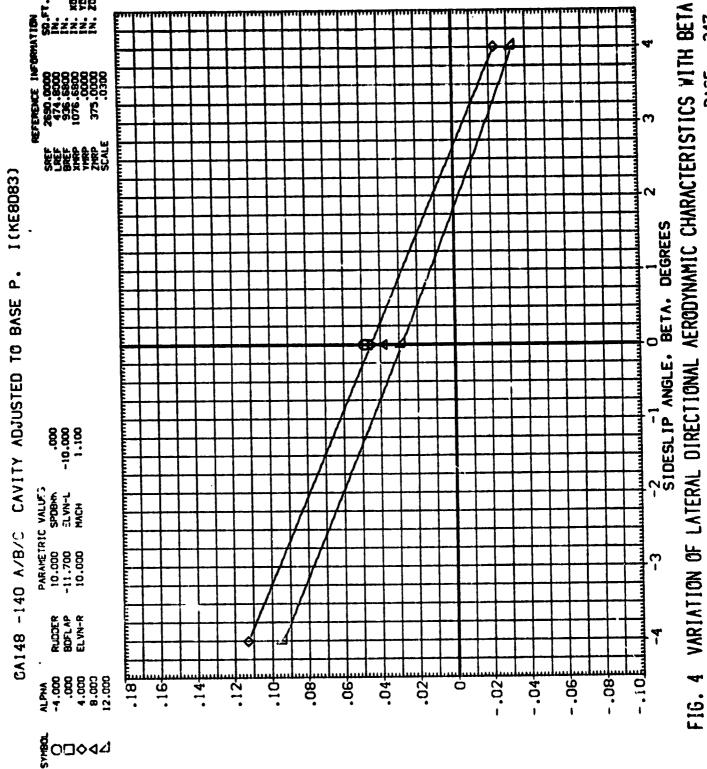




8xxxxx F 858 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 765 ENENCE 1NF 265C 0000 474-8000 935-6820 1076-6800 375-0000 0000 STATE I (KE8082) -2 1 C 1 SIDESLIP ANGLE, BETA, DEGREES CANTIY ADJUSTED TO BASE P. .000 -10.000 1.250 PARAMETRIC VALUES 10.000 SPOBRK -11.700 ELVN-L 10.000 MACH RUDDER BOFLAP ELVN-R - .020点 4.000 4.000 4.000 12.000 子900---.007春 -.011長 -.019 FIG. 4 -.016 -.008<del>[</del> <u>-.009</u> -.012 -.014£ -.010 -.018 -.013 510.--.017 **₹**0□◊44 (BODA VXIZ) AVAING WOWENT COEFFICIENT, CYN

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375.0000 IN. 2 FIG. 4 VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA SAEF LREF XHRP XHRP ZHRP SCALE I (KE8082) -2 -1 0 1 SIDESLIP ANGLE, BETA, GEGREES ۵. CAVITY ADJUSTED TO BASE غر -10.000 1.250 PARAMETRIC VALUES 10.000 SPDBRK -11.700 ELVN-L 10.000 MACH UA148 -140 A/B/C RUDDER BOFLAP ELVN-R ALPHA -4.000 4.000 8.000 12.000 -.028<del>∳</del> -.070€ ₹900°--.016 - .024훈 -.026<del>}</del> -.012 -.030--.010<del>.</del> -.004 - 008 -.014 -.018 -.022 **№**0□◊4△ (BQDA VXIZ) ROLLING MOMENT COEFFICIENT, CBL

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VARIATION OF LATERAL DIRECTIONAL AERODYNAMIC CHARACTERISTICS WITH BETA 248 F16. 4

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I (KE8D83)

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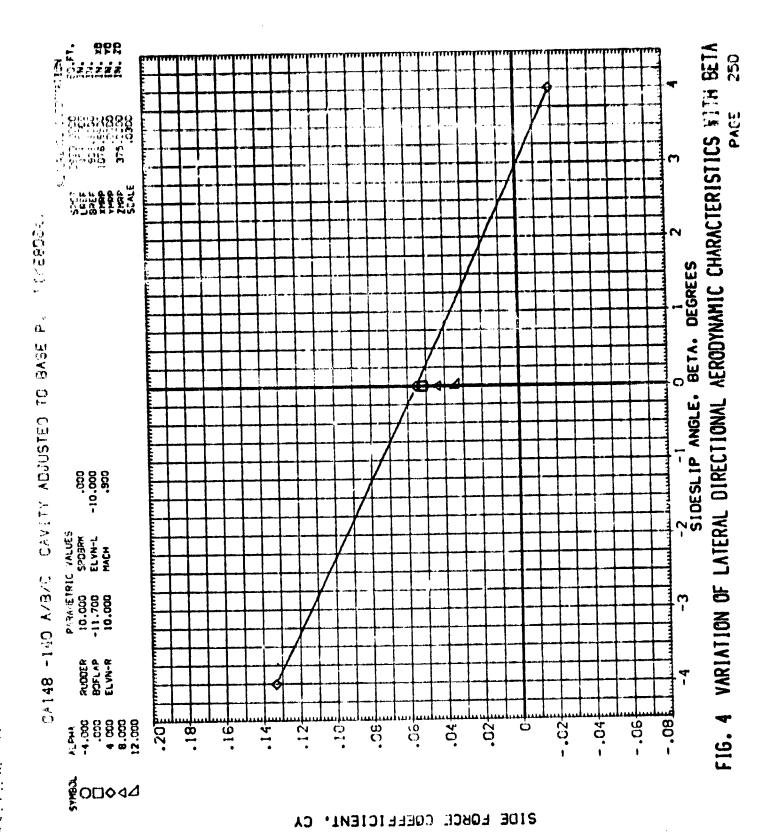
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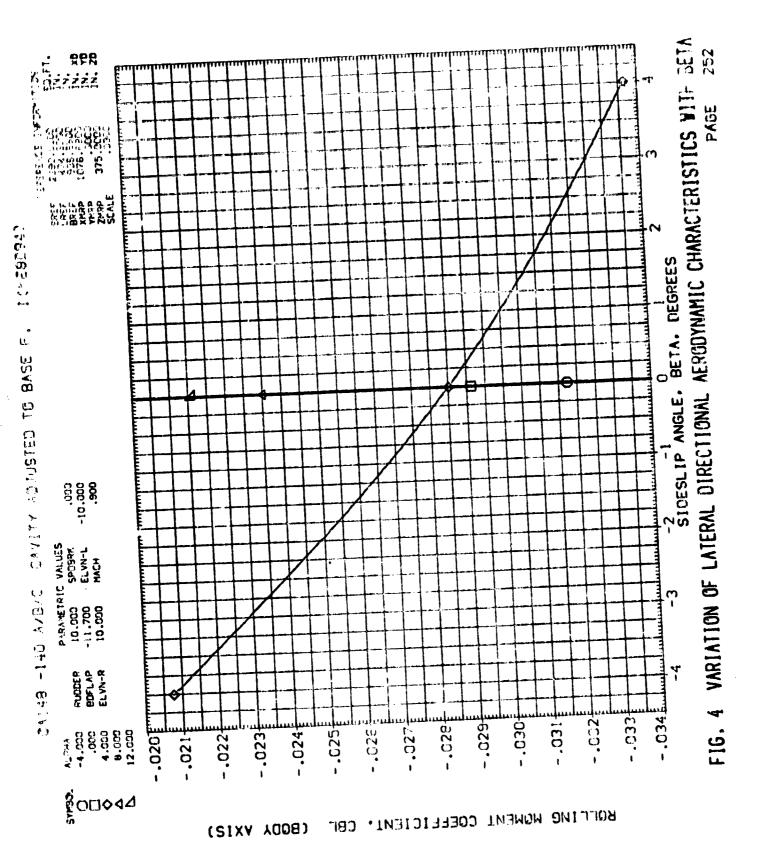
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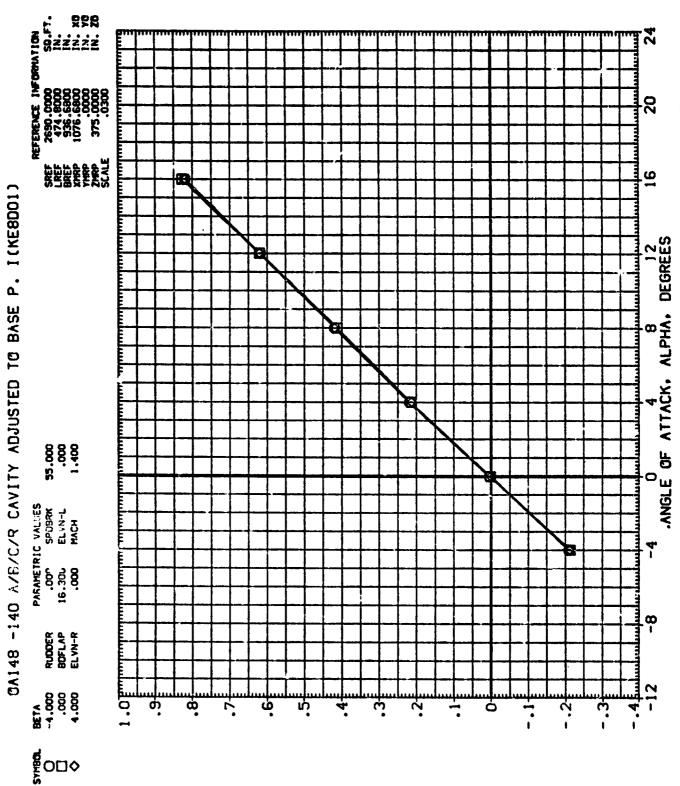
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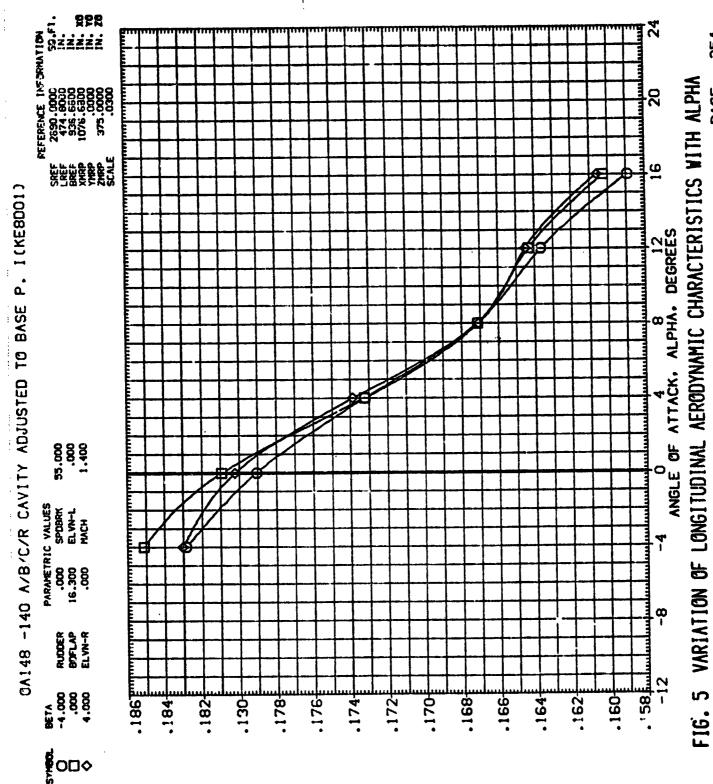
FIG. 4 VARIATION OF LATERAL DIRECTIONAL AFRODYNAMIC CHARACTERISTICS WITH BETA





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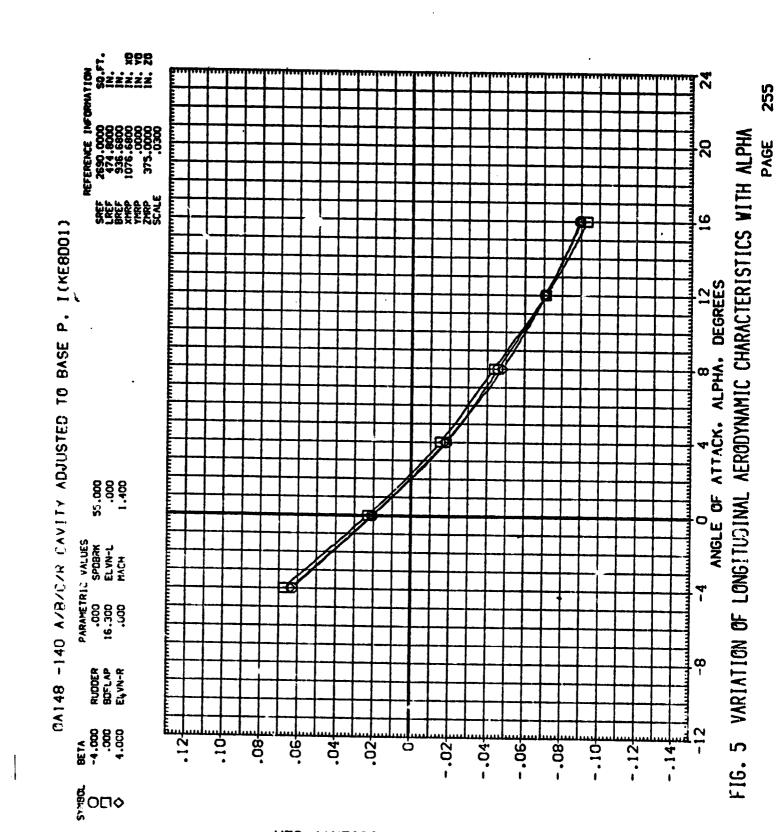
FIG. S VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



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AXIAL FORCE COEFFICIENT, CA



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NORMAL FORCE COEFFICIENT,

12 FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA 0 တ O 1 2 3 4 5 6 7 ANGLE OF ATTACK. ALPHA. DEGREES

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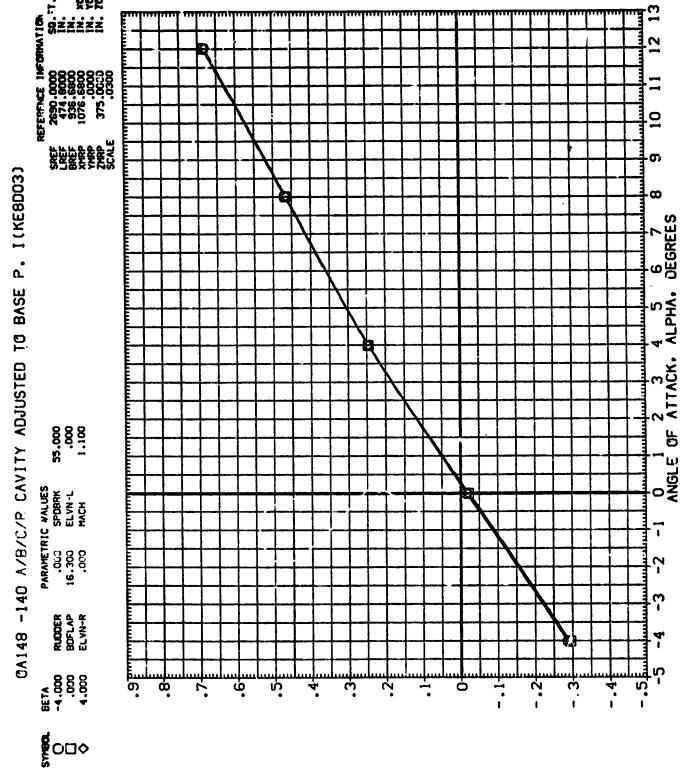
SREF KARP XMRP XMRP SCALE

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

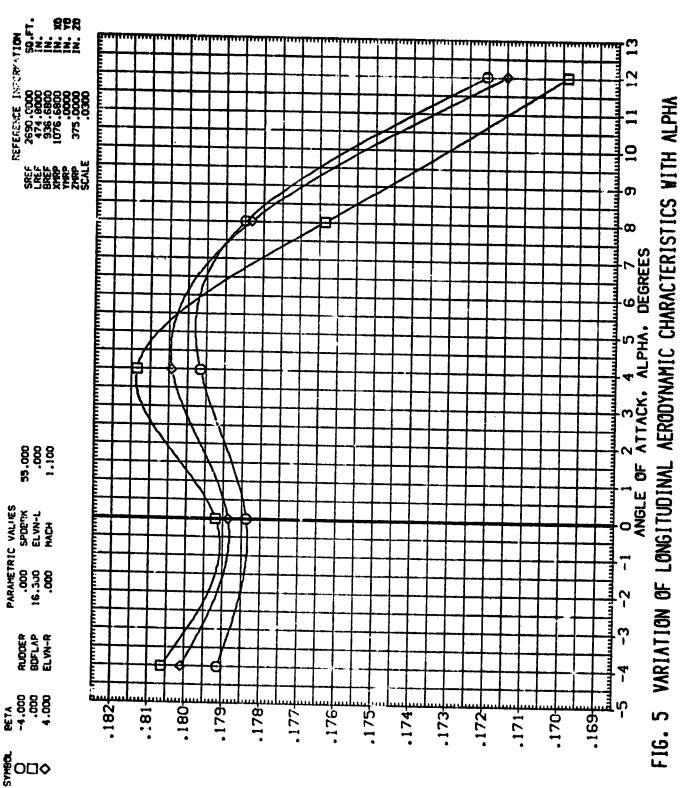
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PITCHING MOMENT COEFFICIENT,



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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



AXIAL FORCE COEFFICIENT,

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PITCHING MOMENT COEFFICIENT, CLM

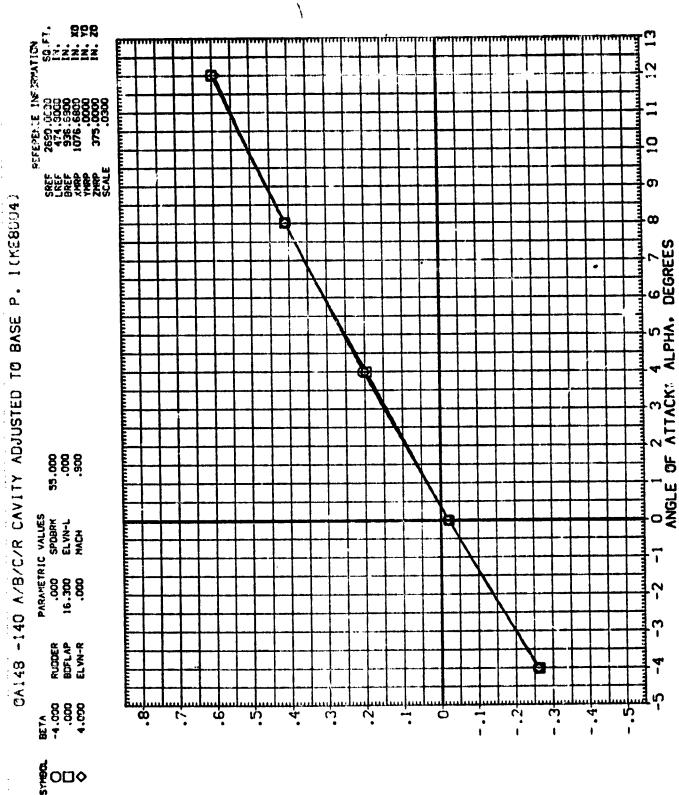
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VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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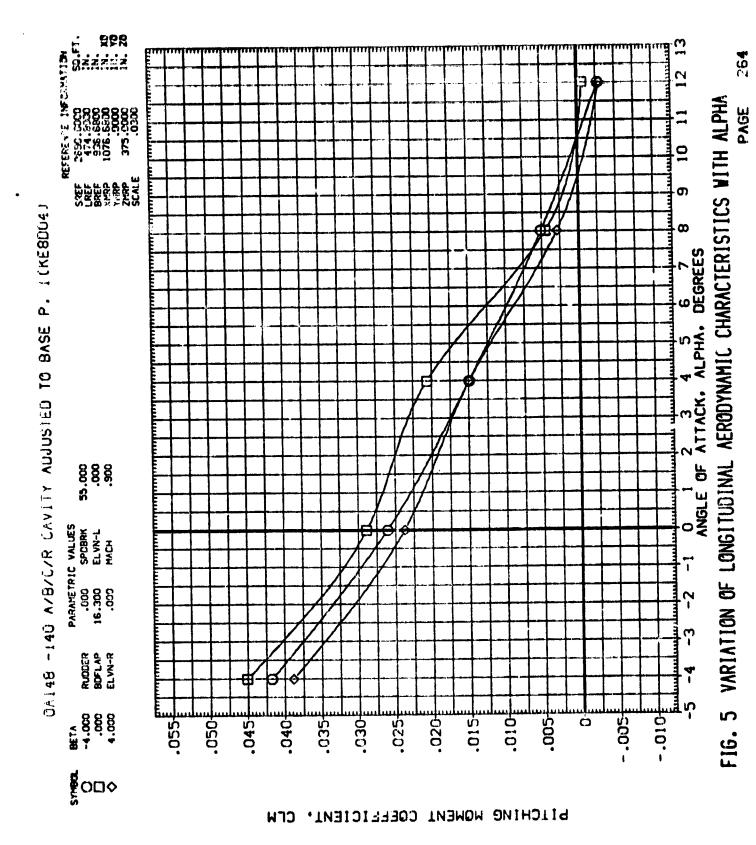
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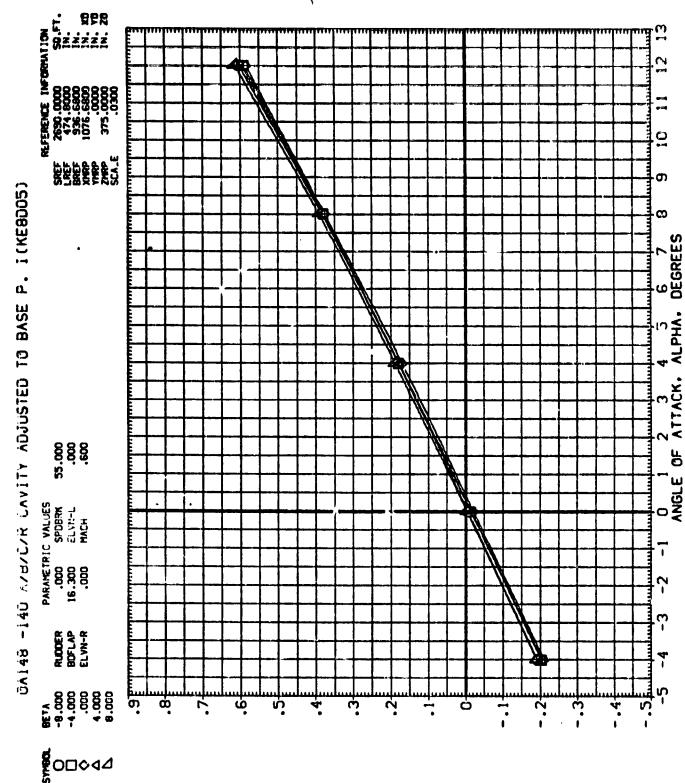


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

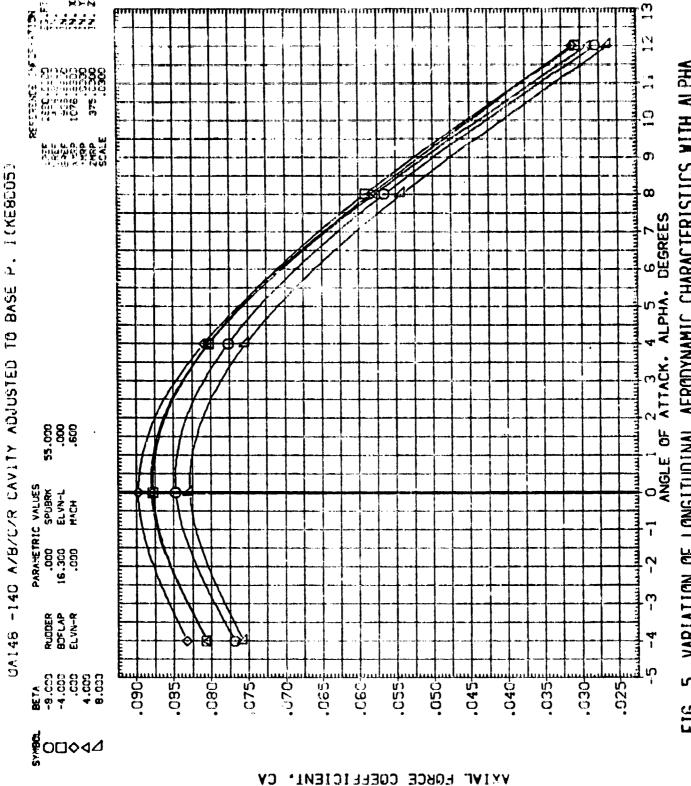
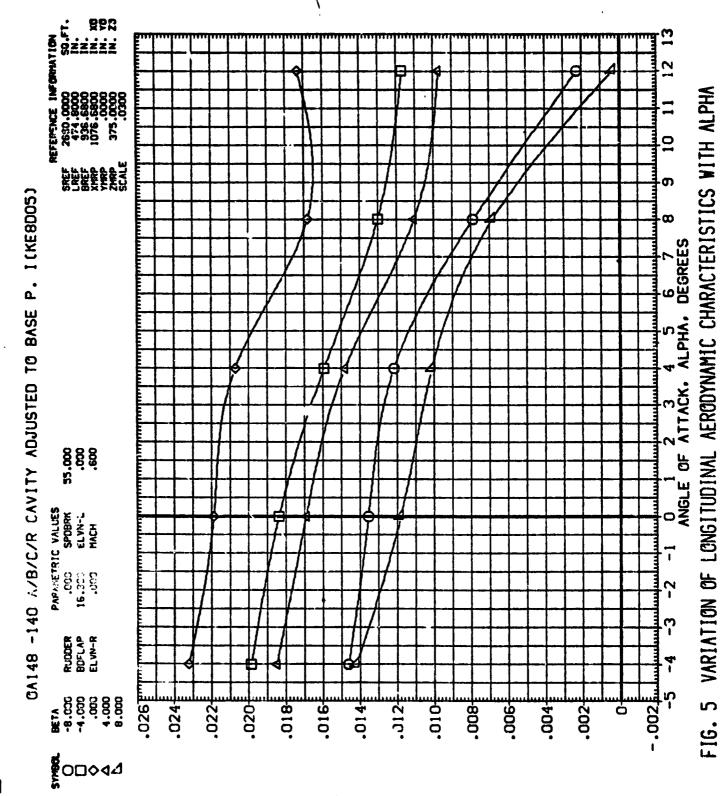


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

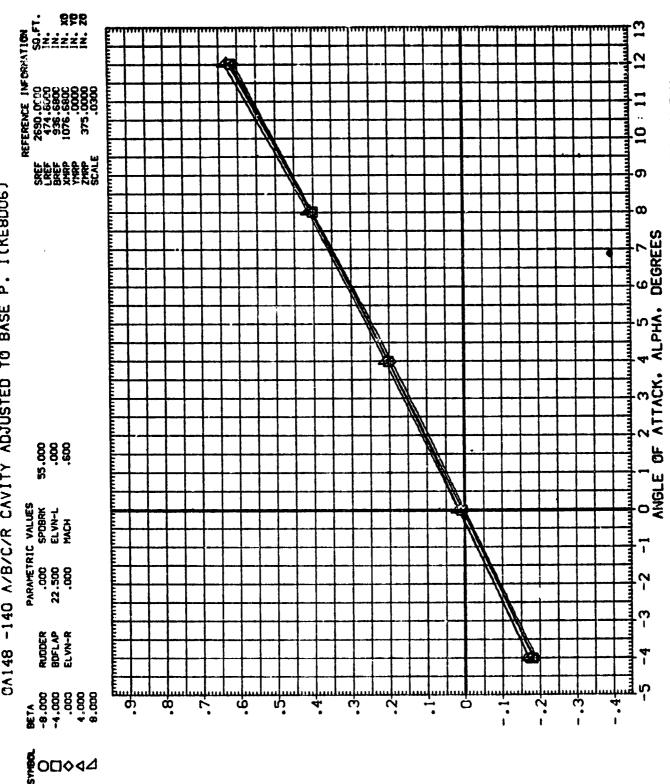


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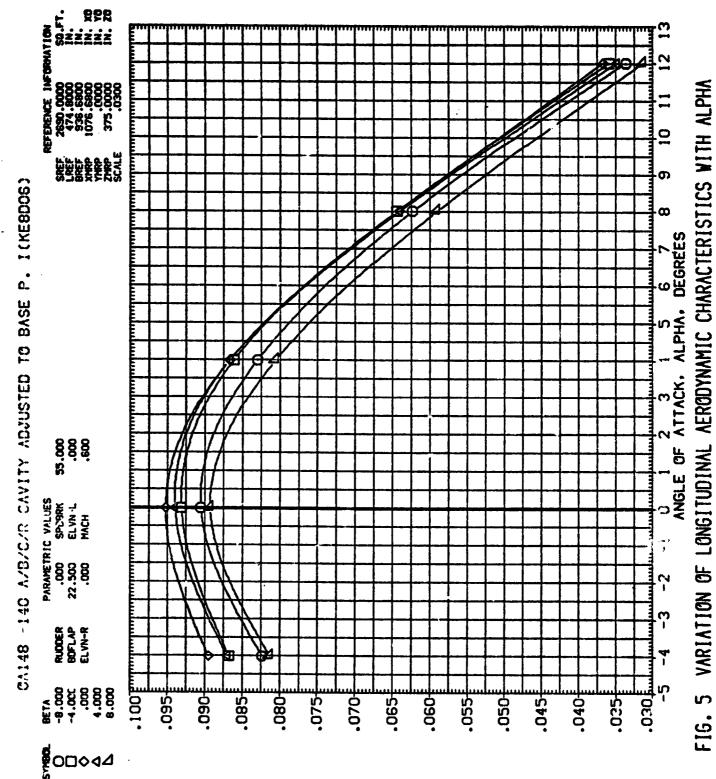


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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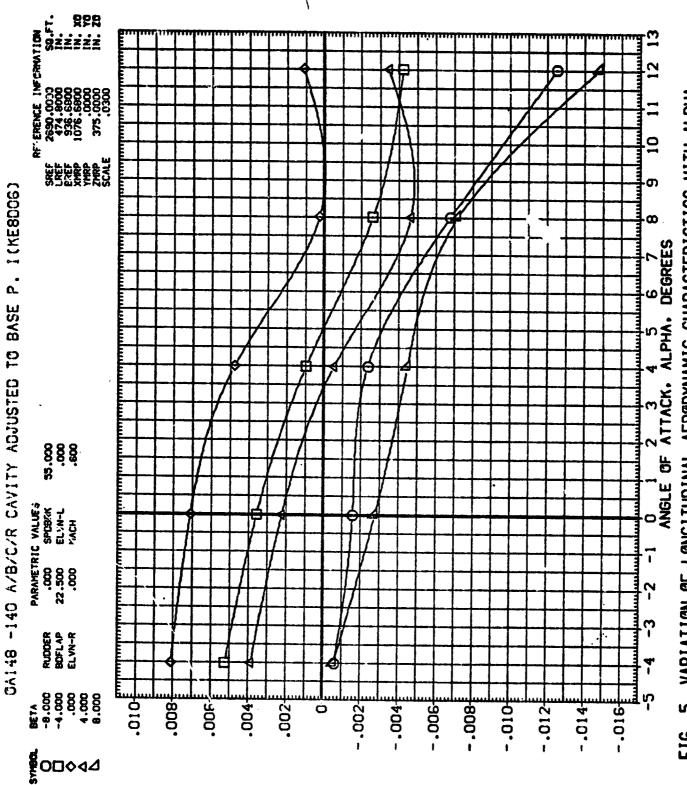
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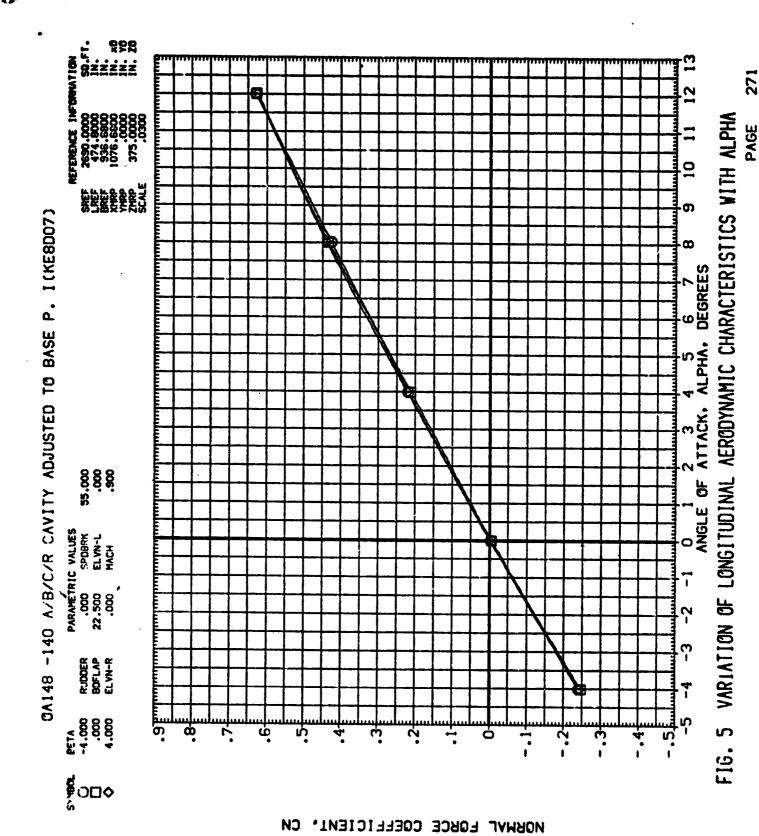
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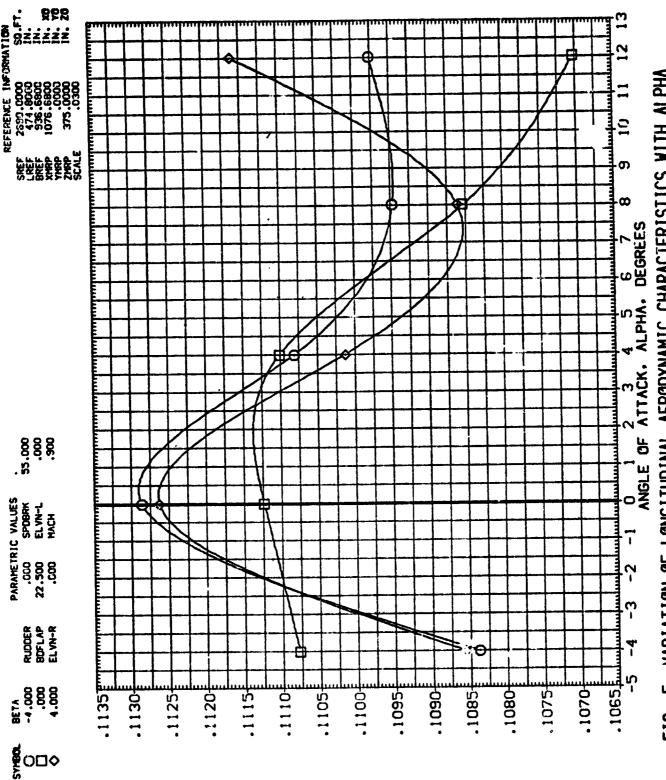
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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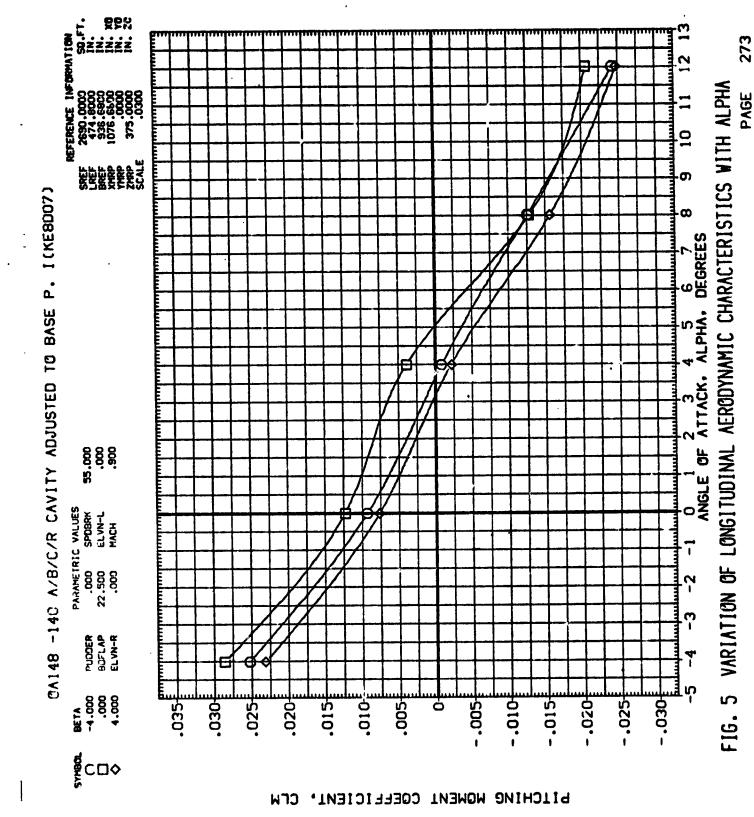
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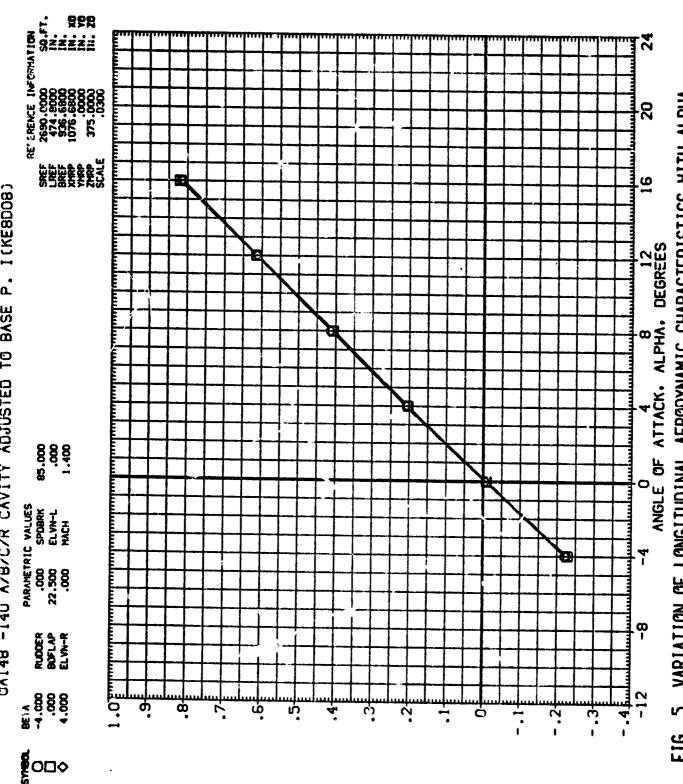
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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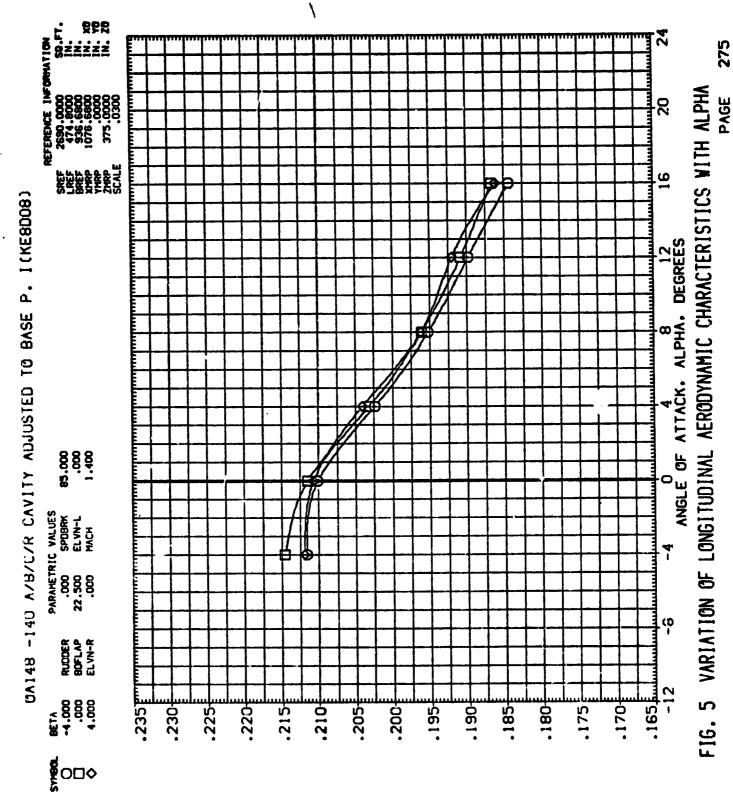


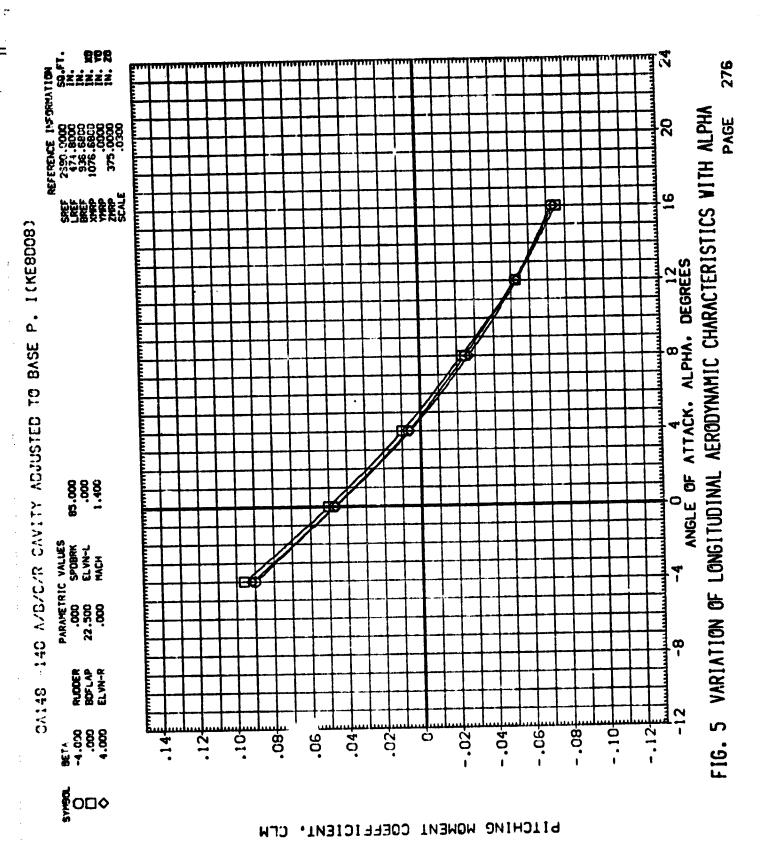
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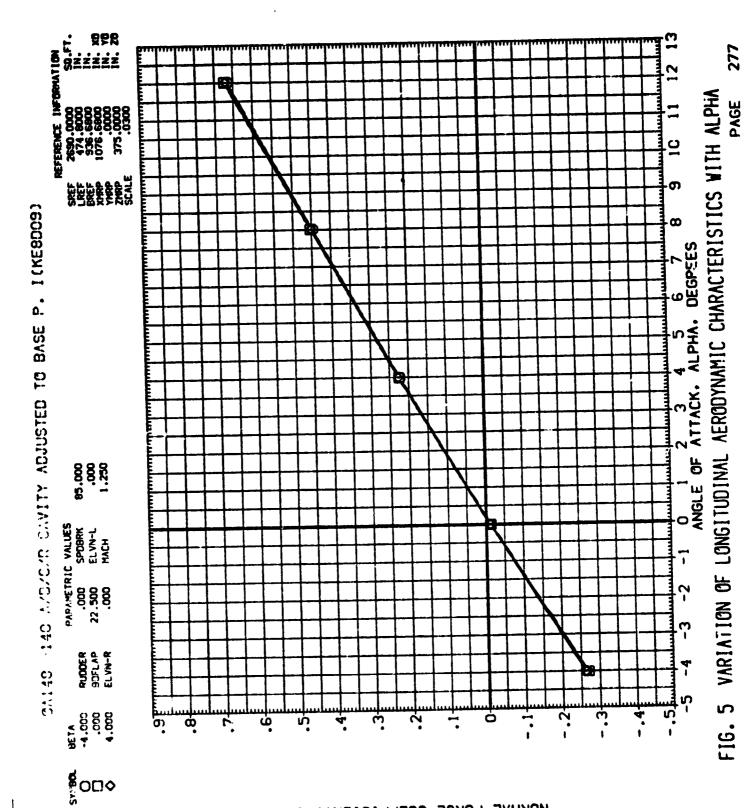
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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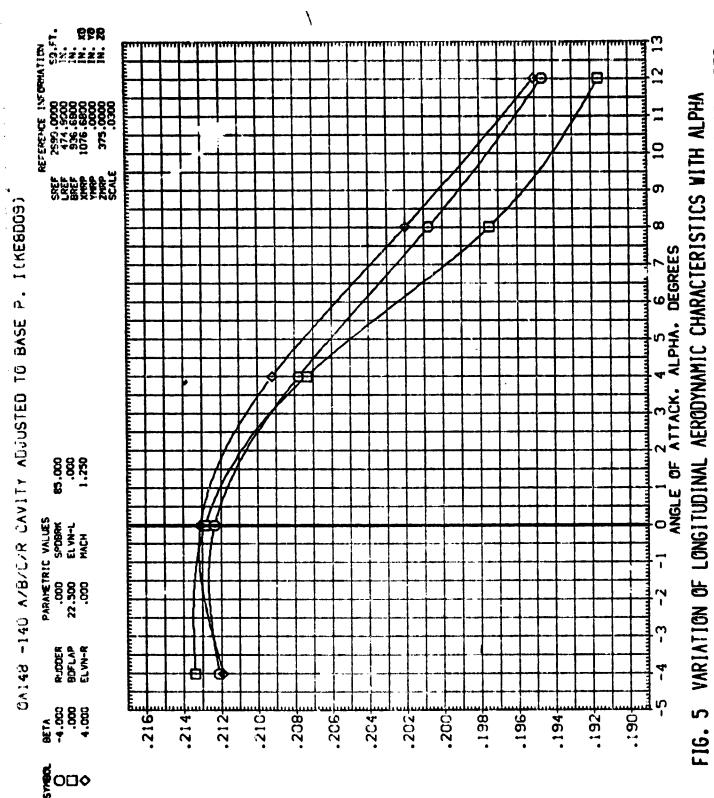






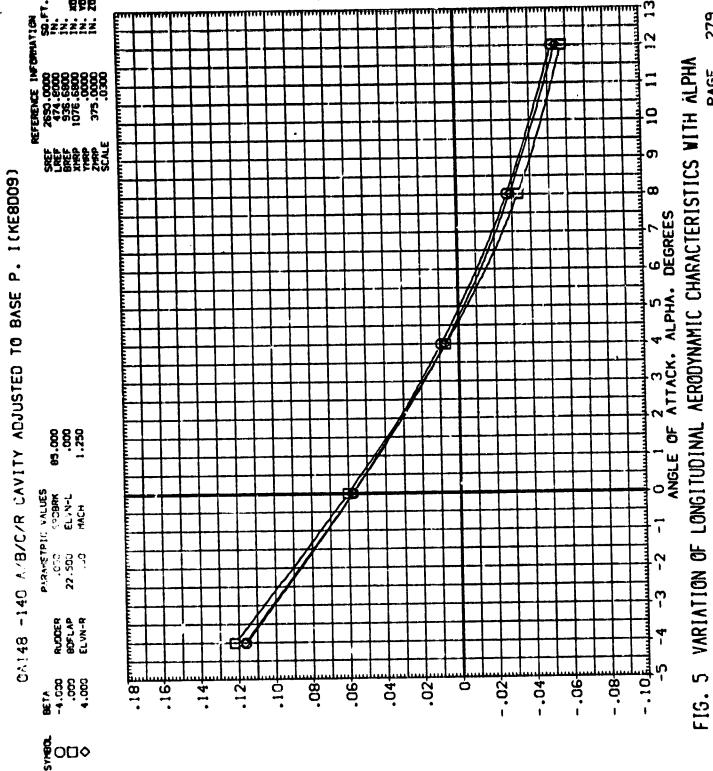
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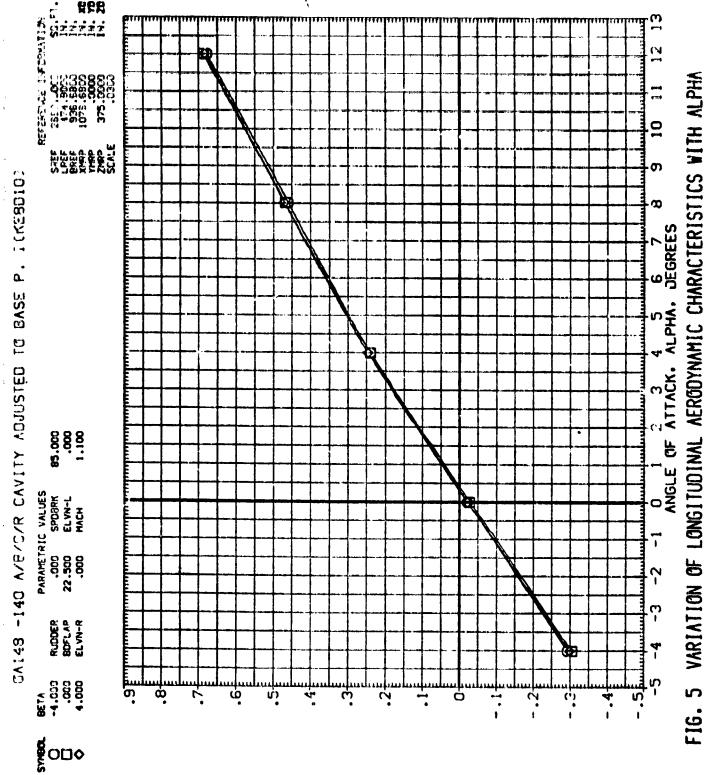


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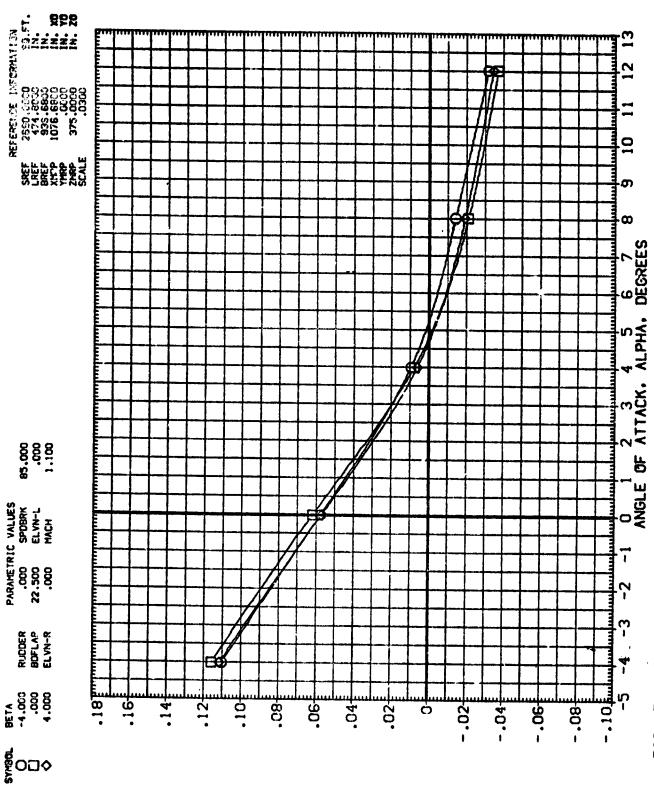
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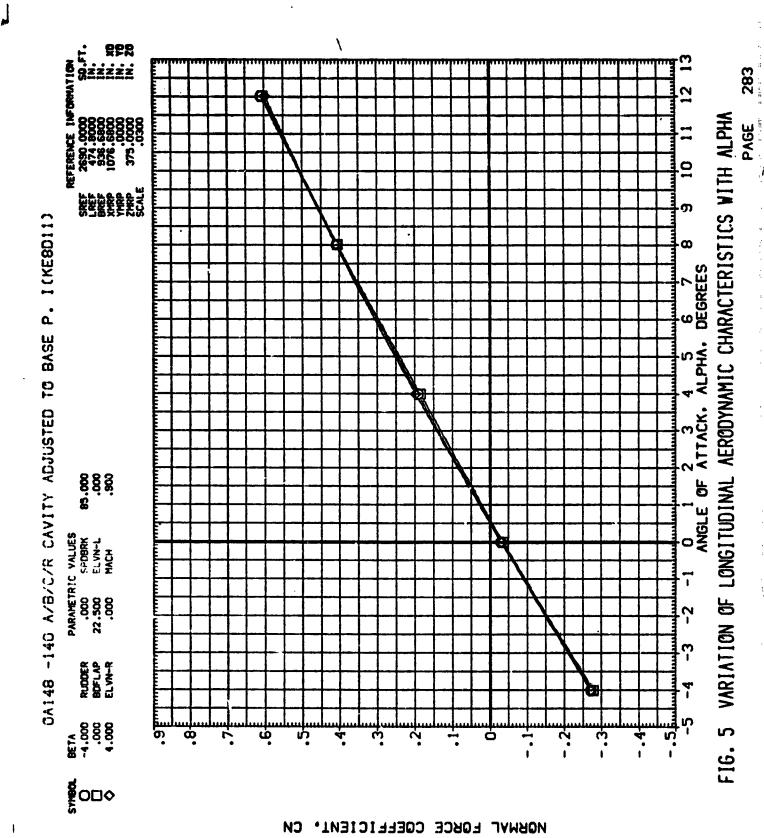
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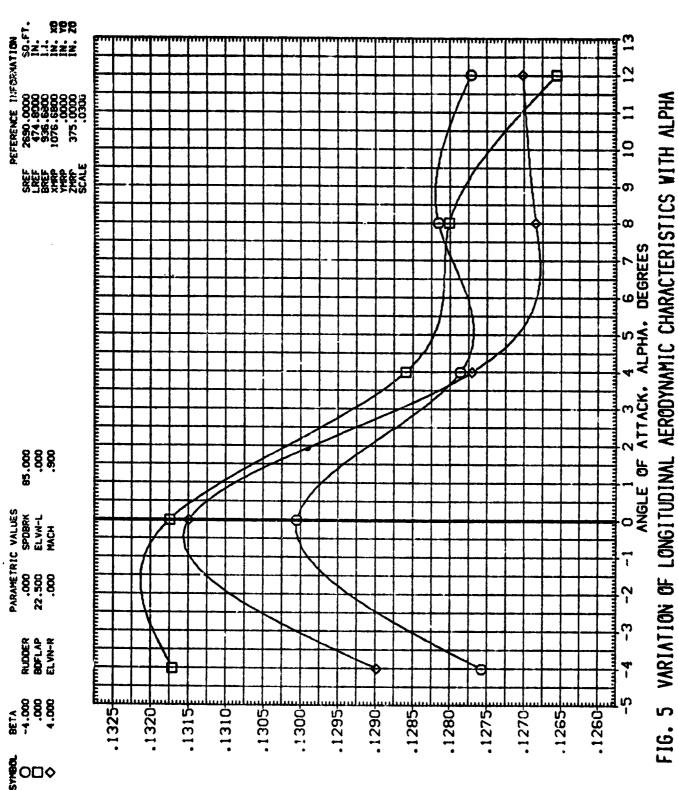


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FIG. 5 VARIATION OF LONGITUDINAL AFRODYNAMIC CHARACTERISTICS WITH ALPHA

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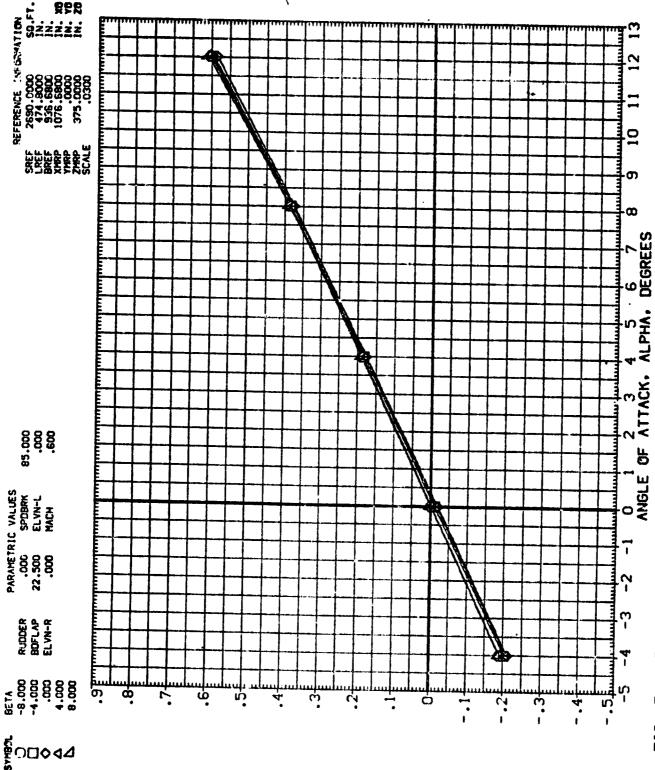
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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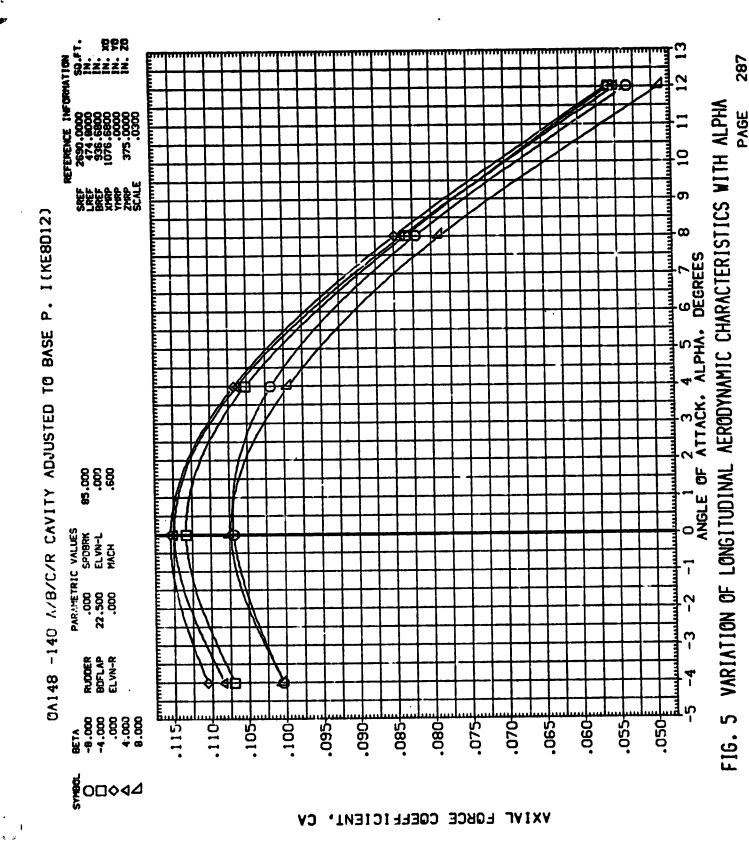


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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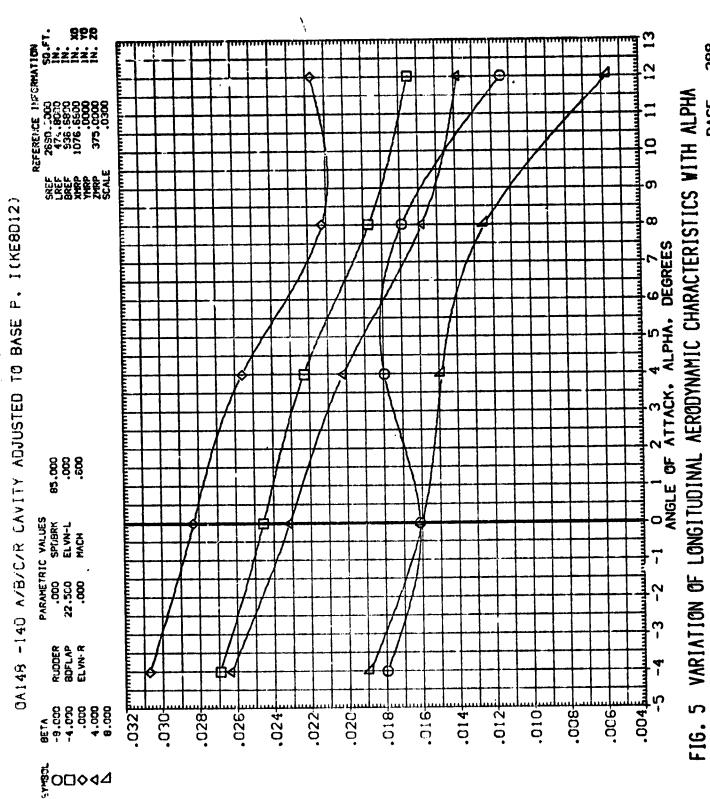


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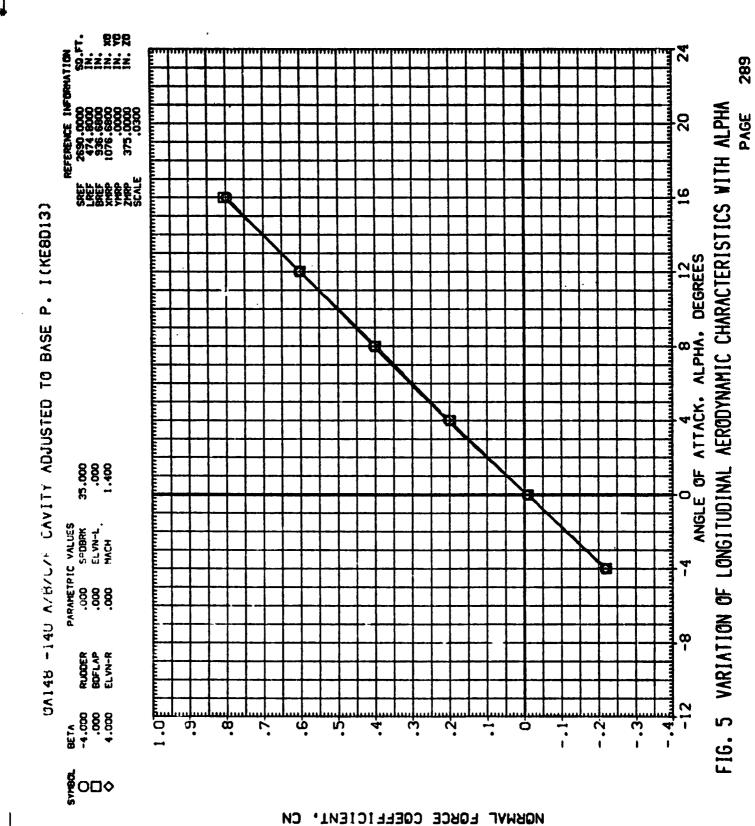
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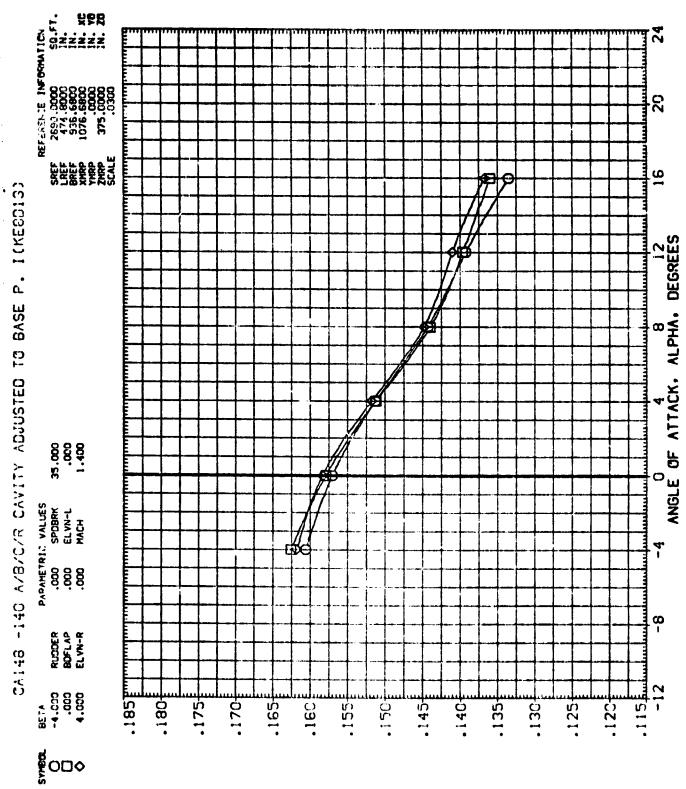
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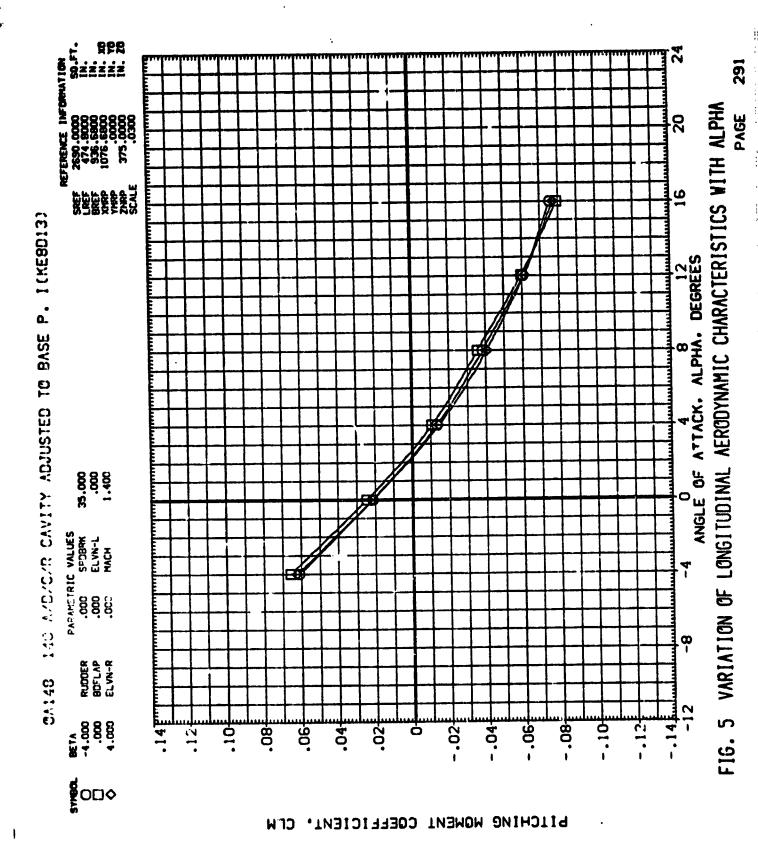


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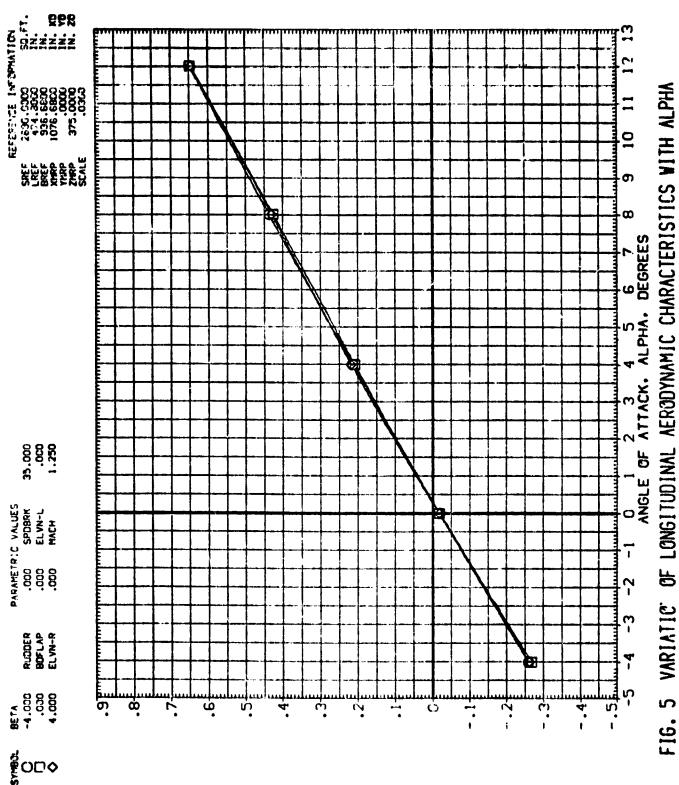


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



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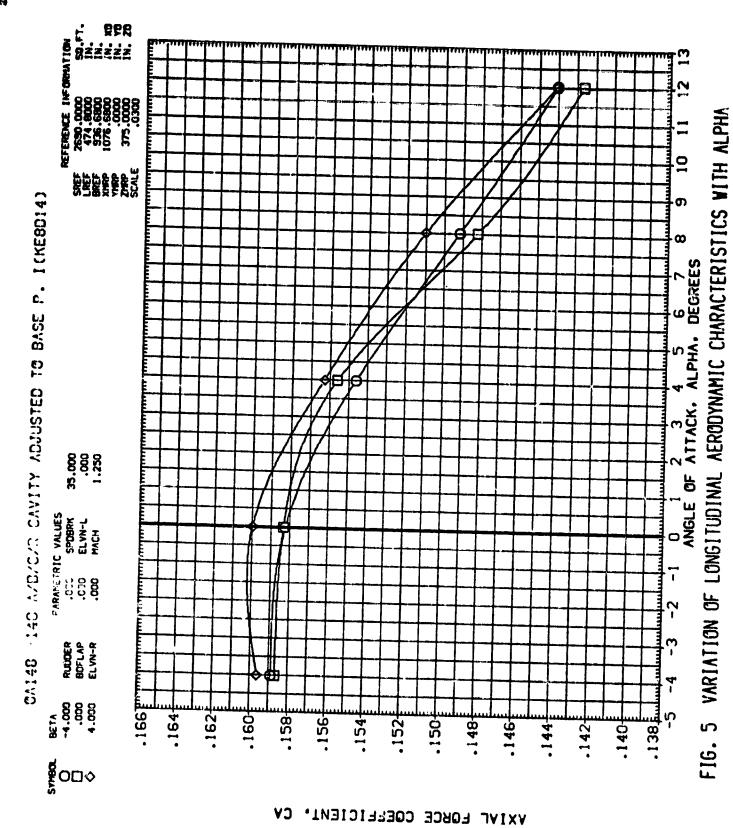


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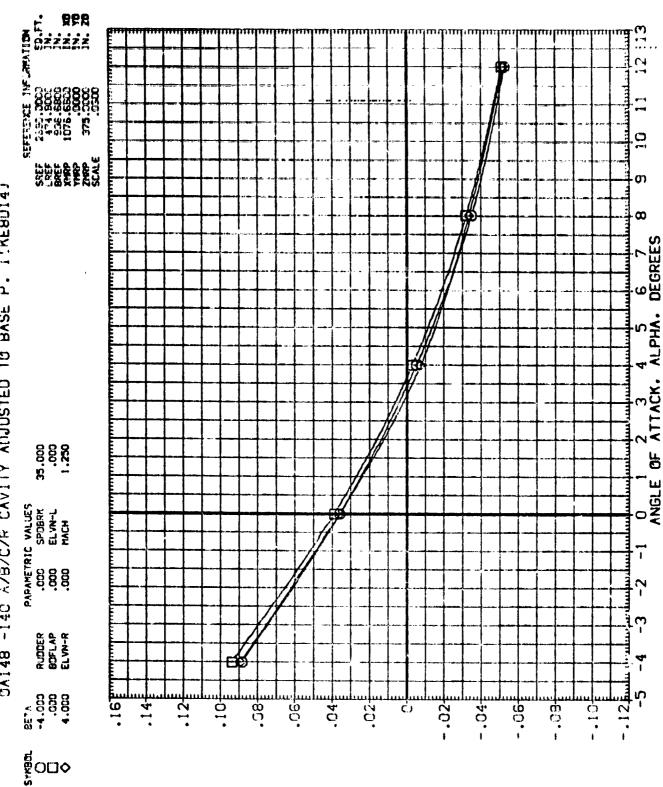
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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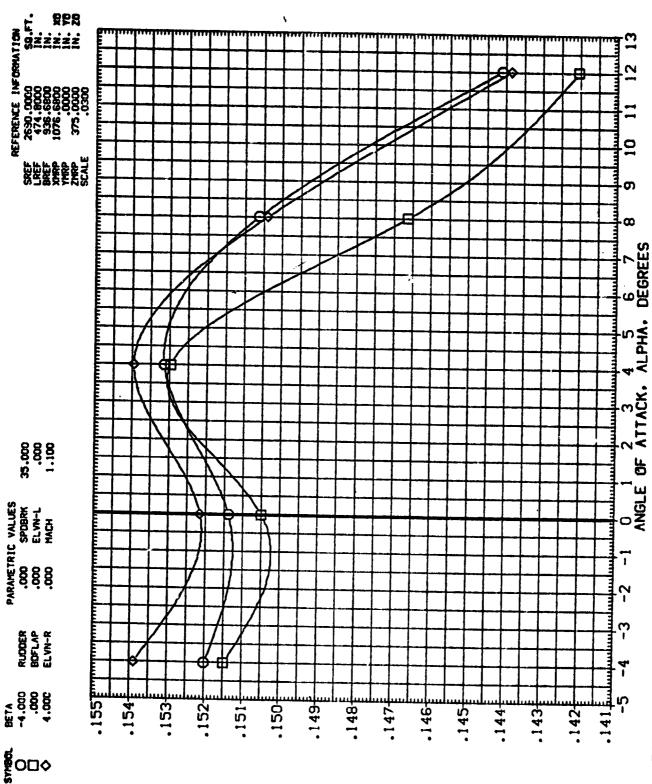
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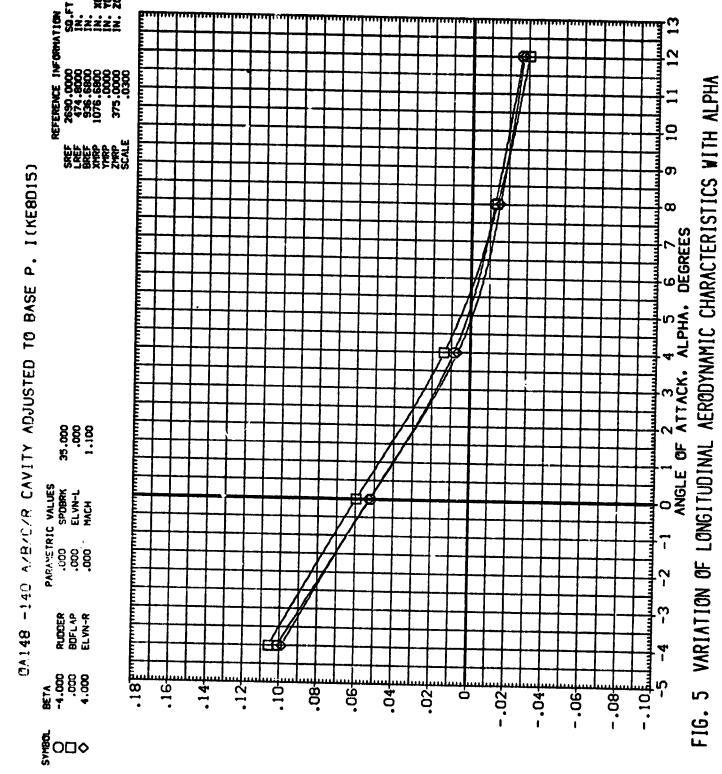
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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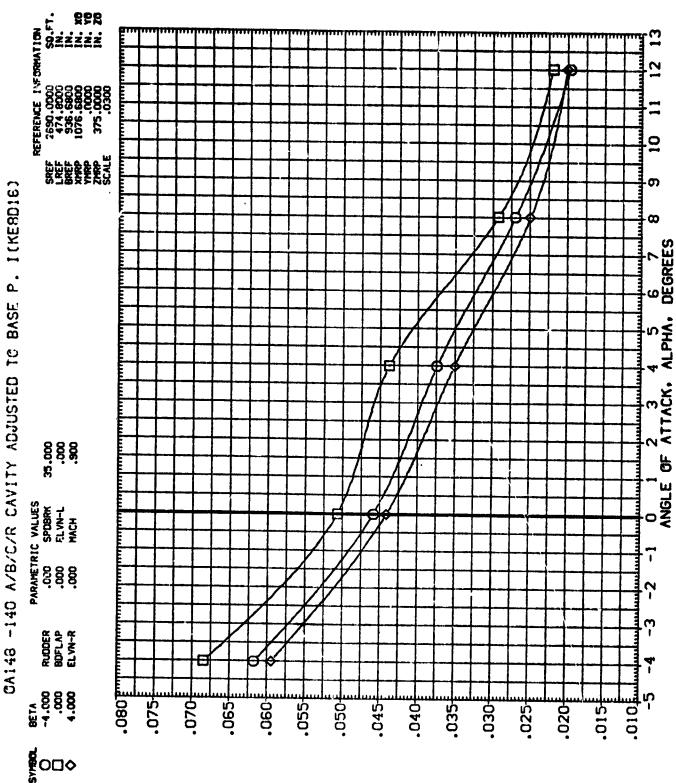
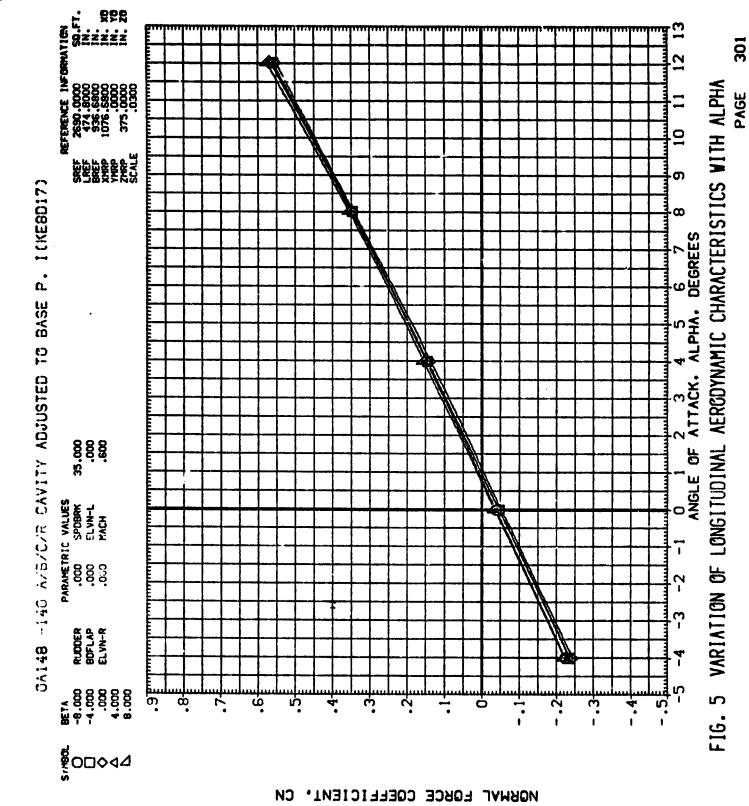
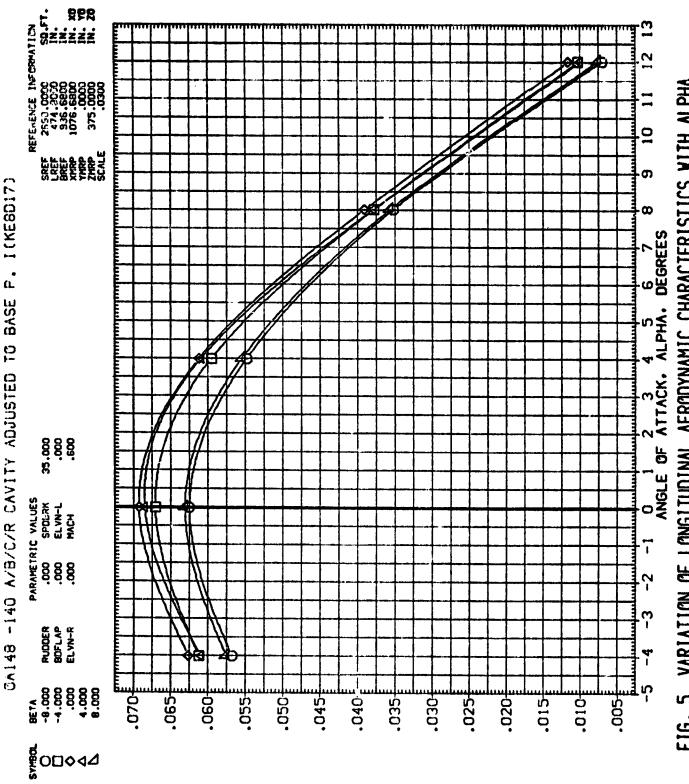


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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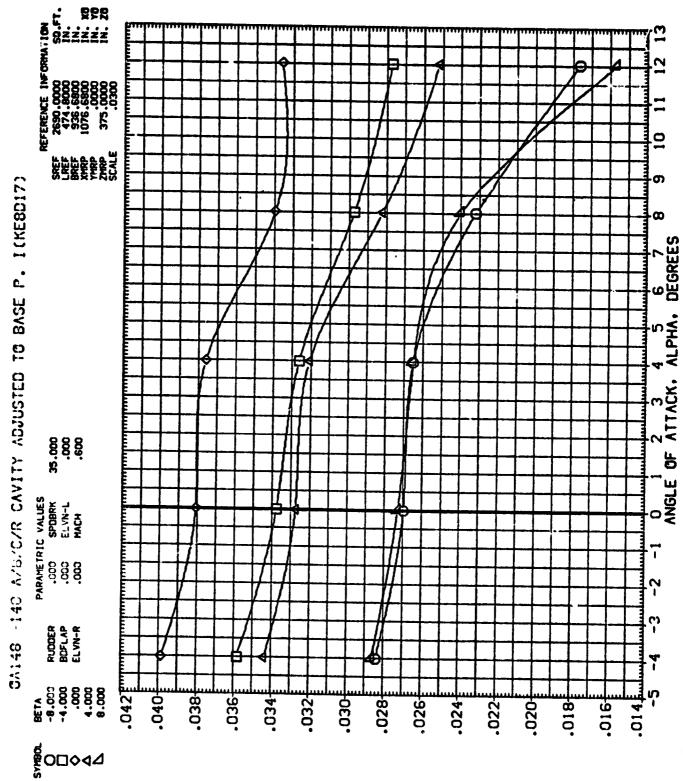




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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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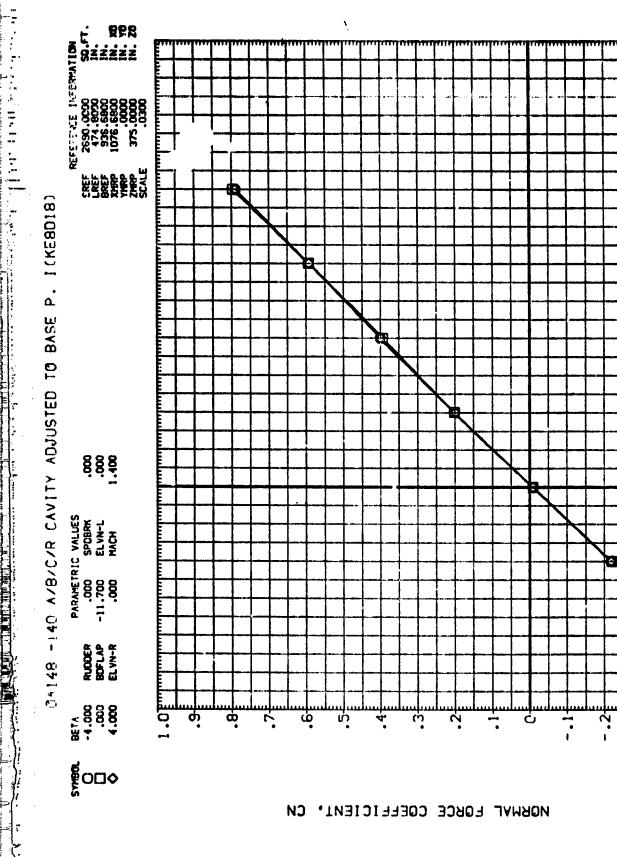
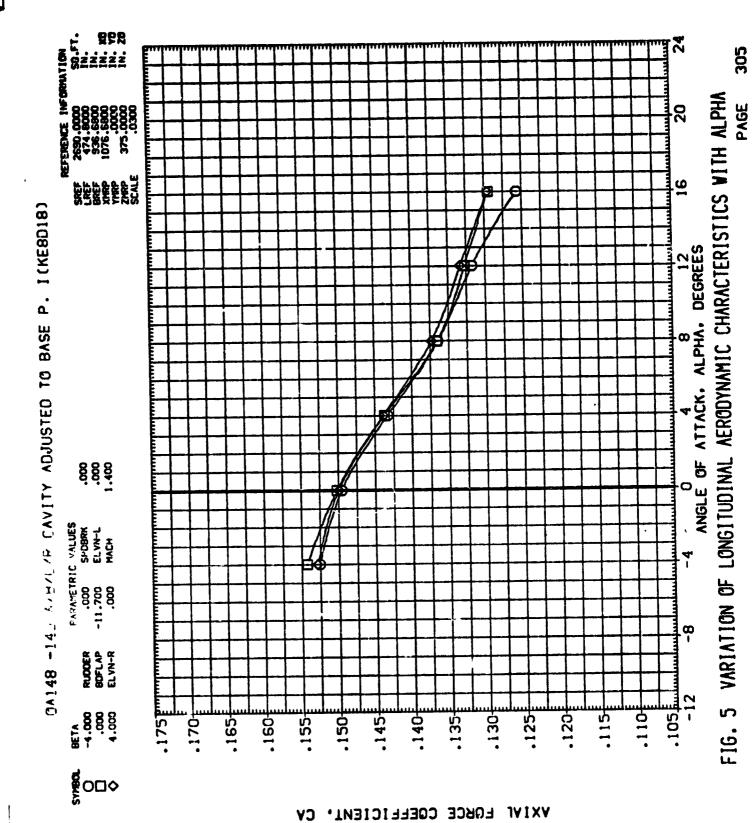


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE O 4 8 12 ANGLE OF ATTACK, ALPHA, DEGREES

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306 FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE O 4 8 12 ANGLE OF ATTACK, ALPHA, DEGREES

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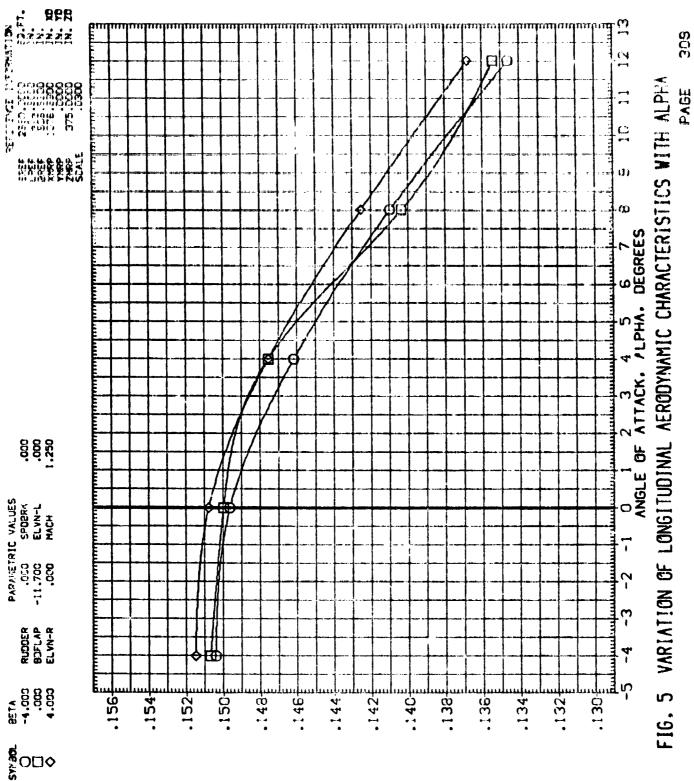
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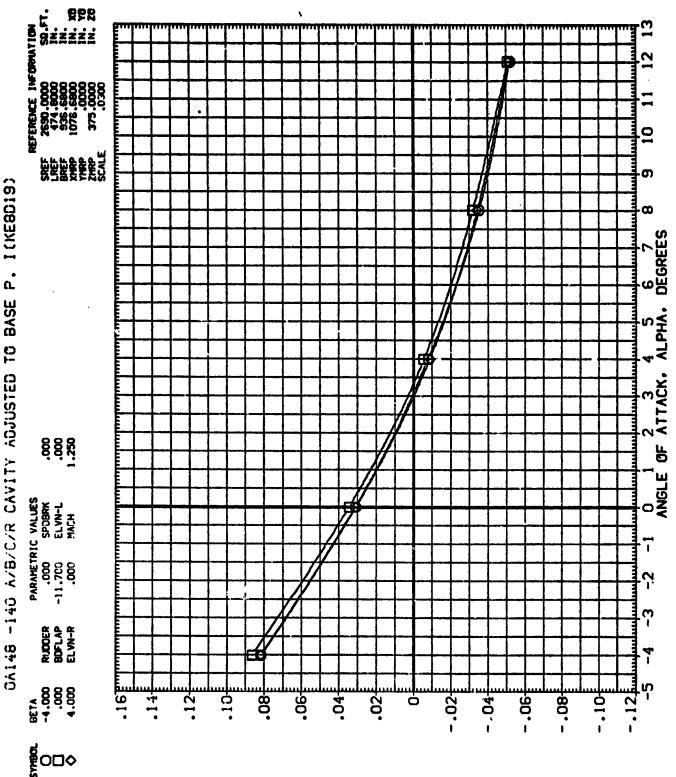
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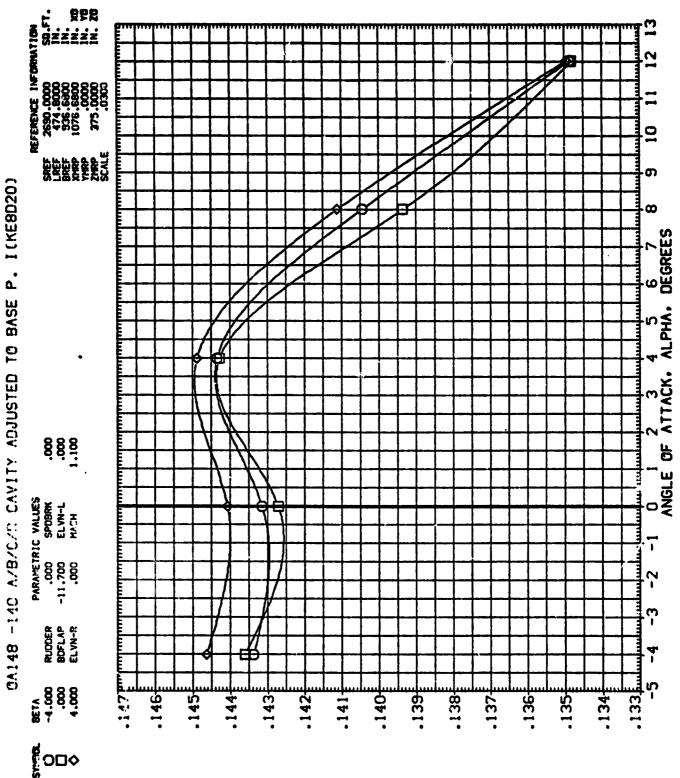
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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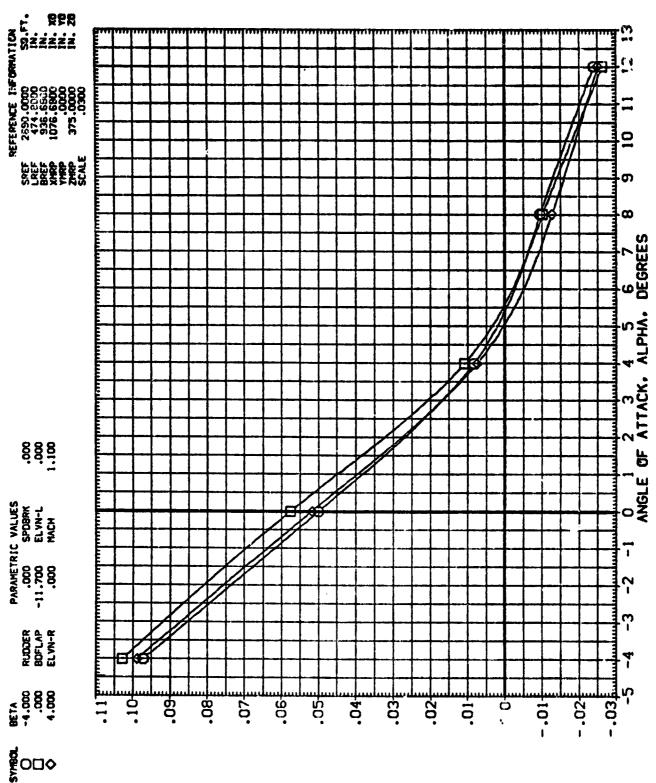
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



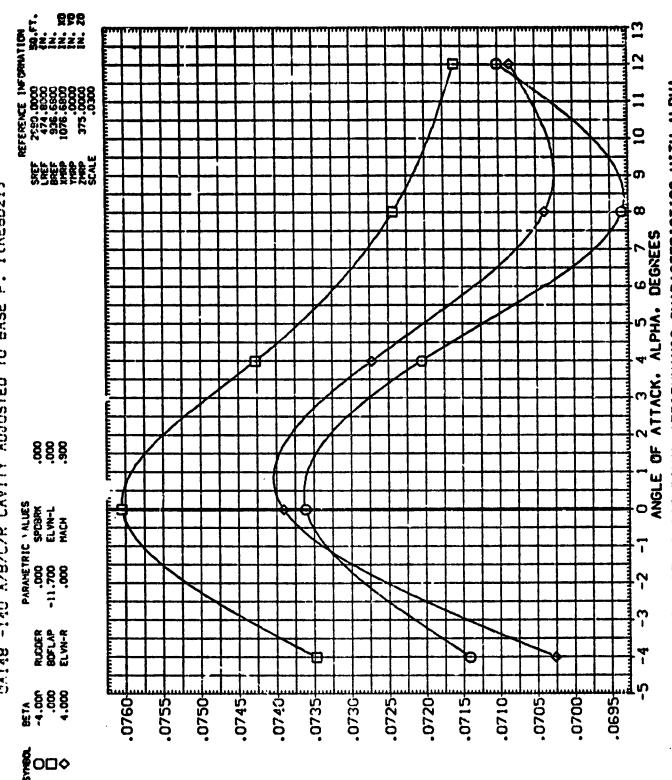
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



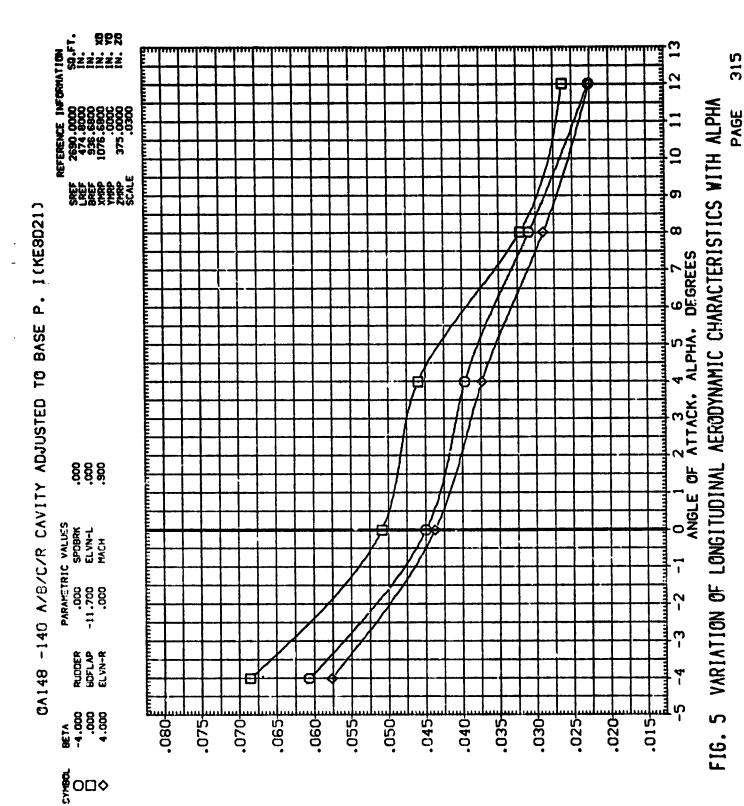
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



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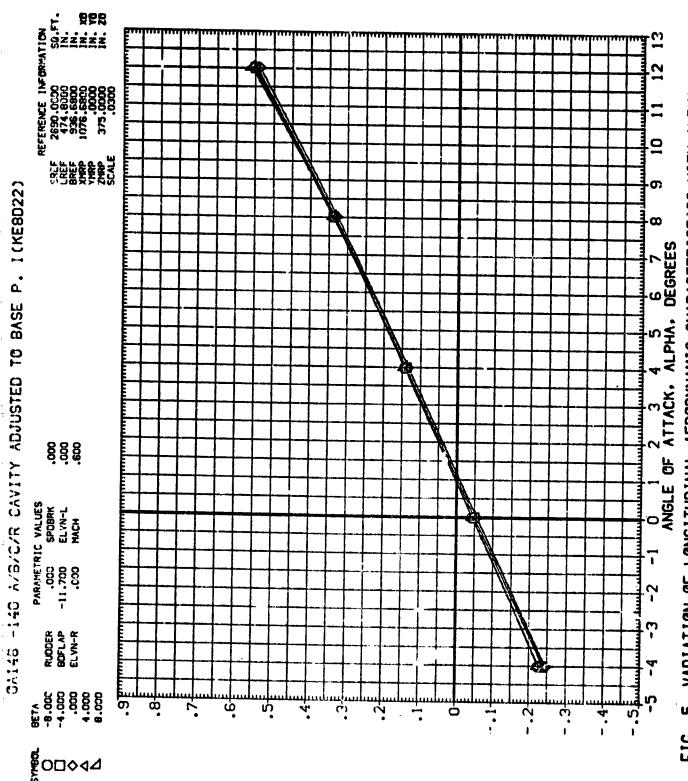
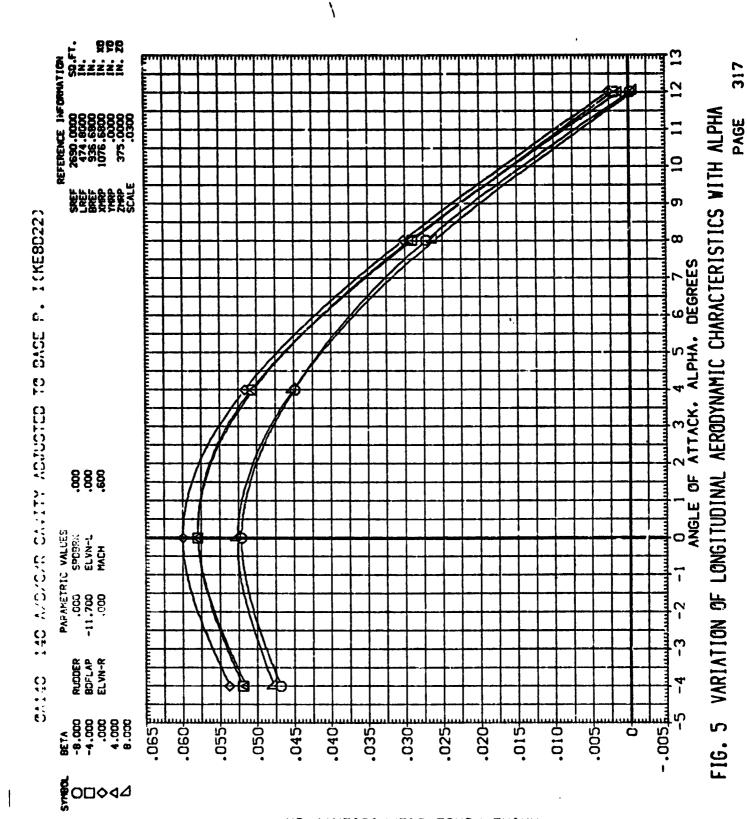


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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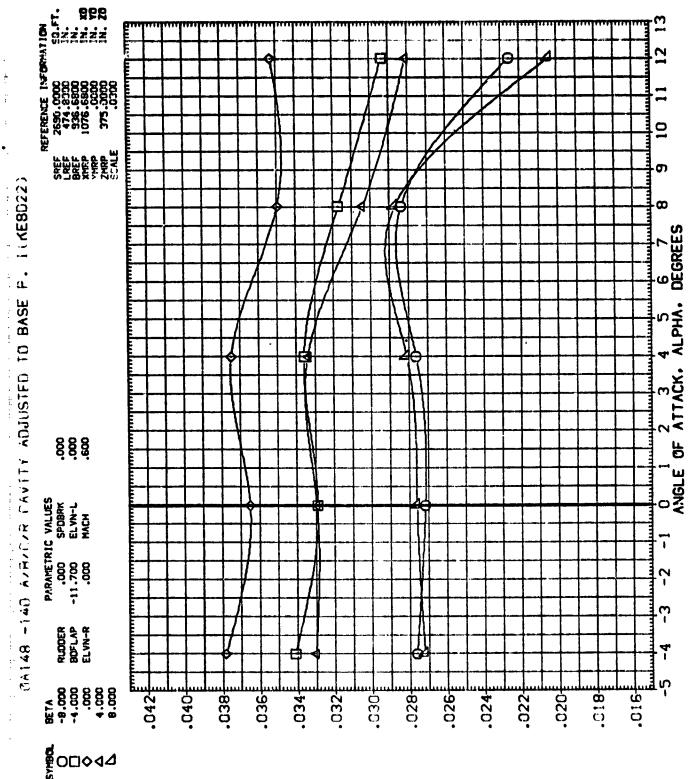
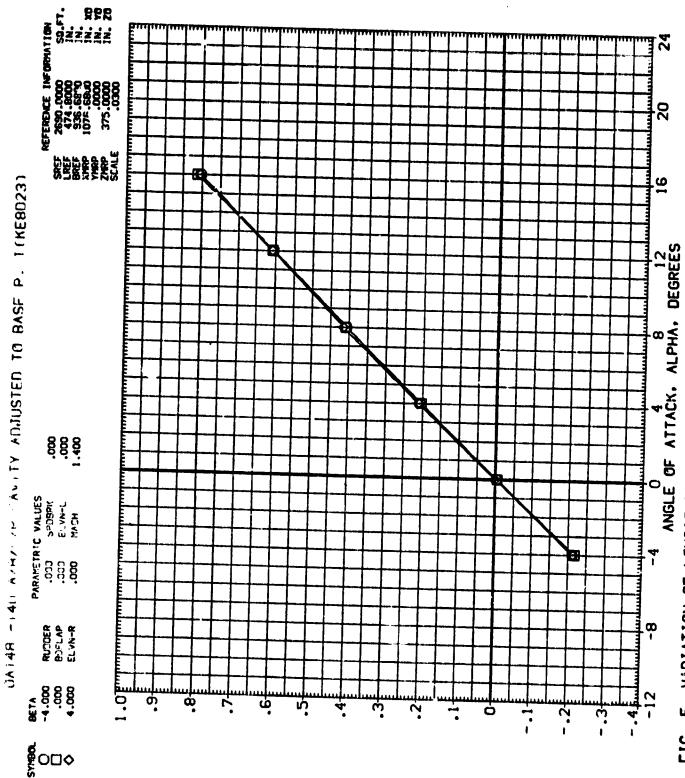
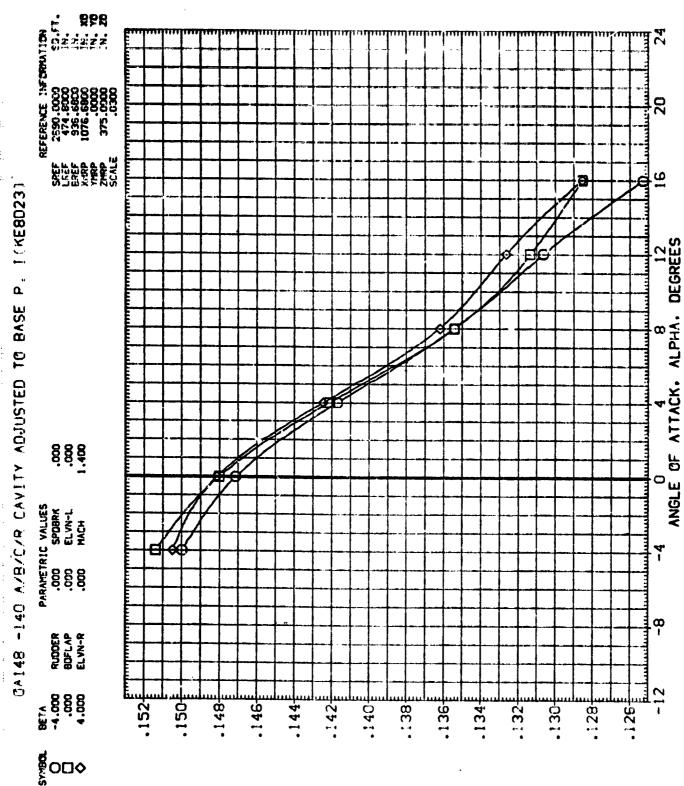


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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NORMAL FORCE COEFFICIENT,



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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

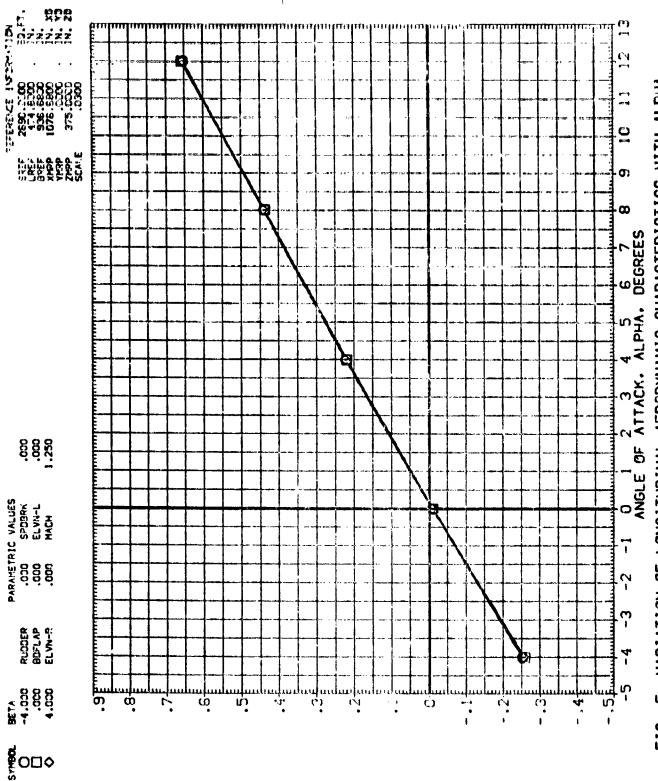
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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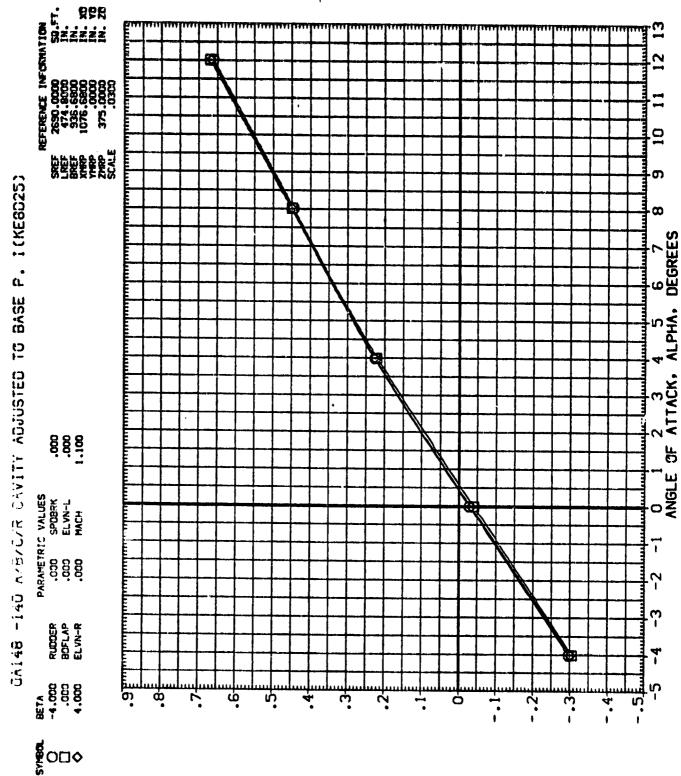
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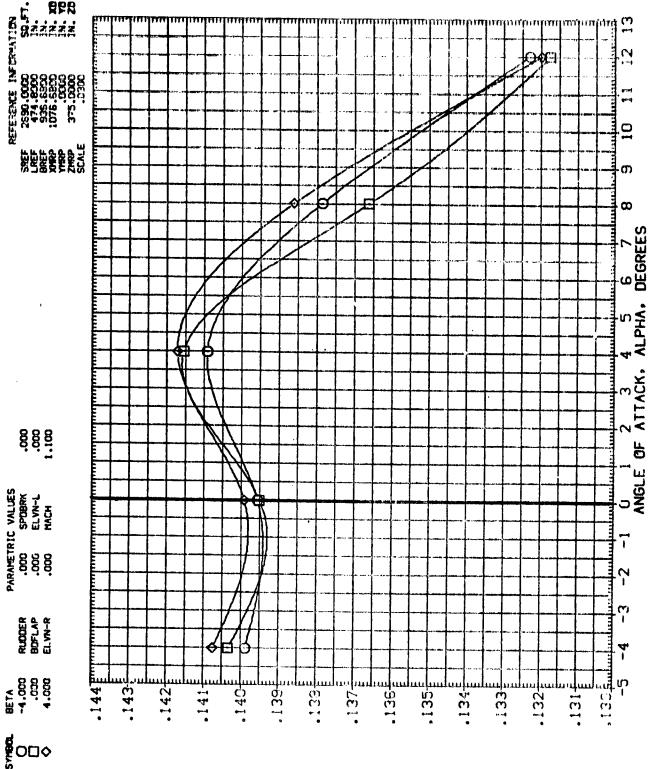
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



NORMAL FORCE COEFFICIENT, CN

FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

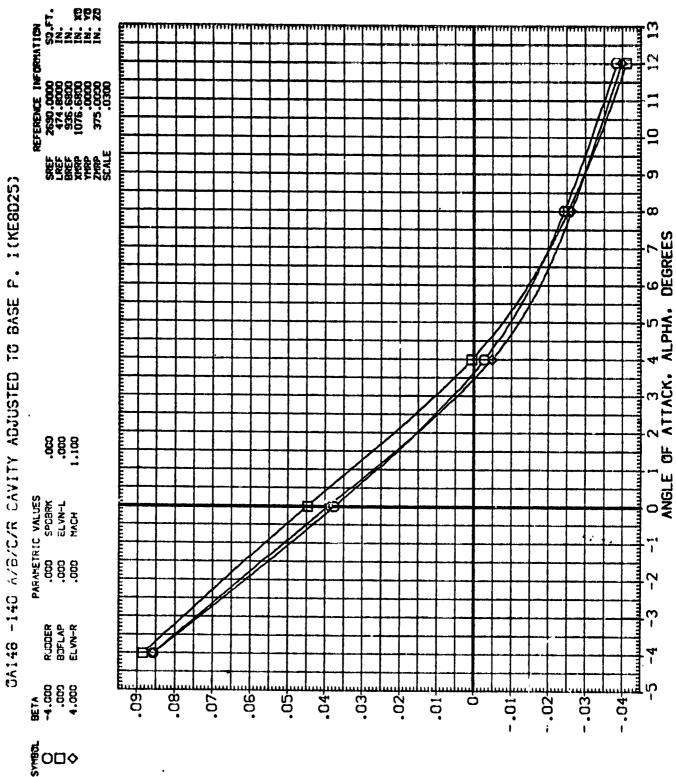
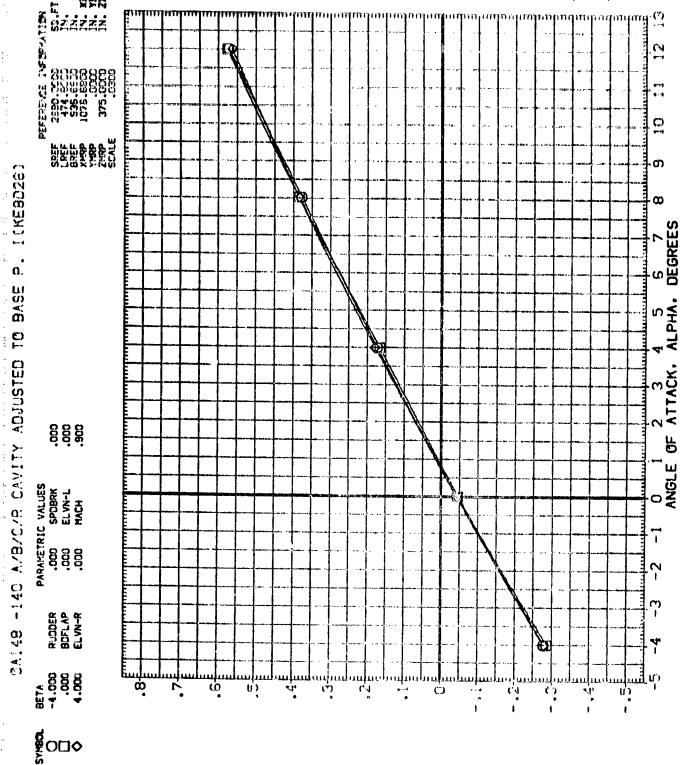


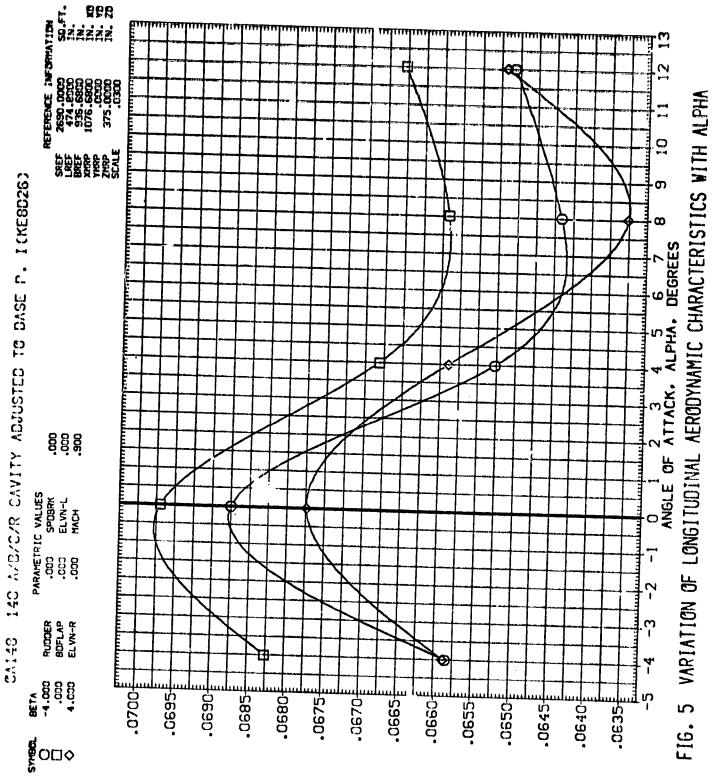
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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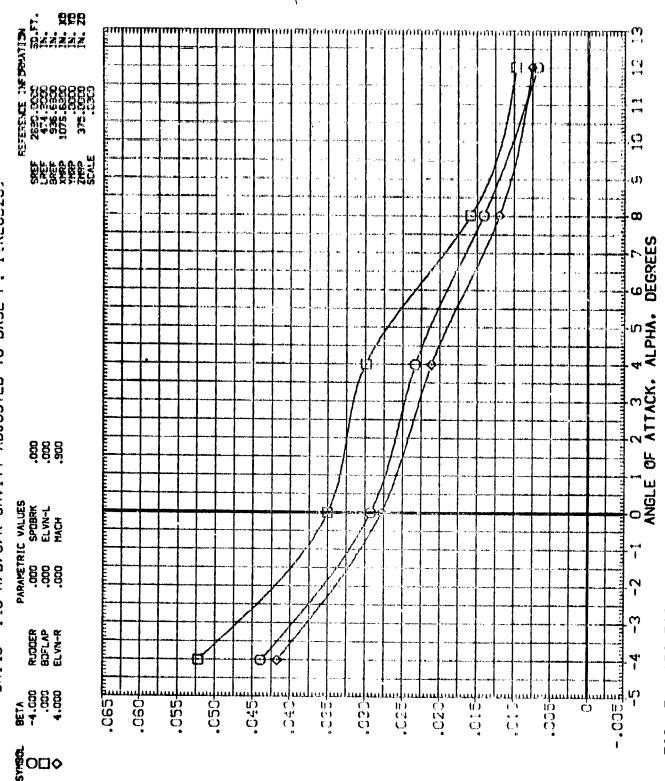
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



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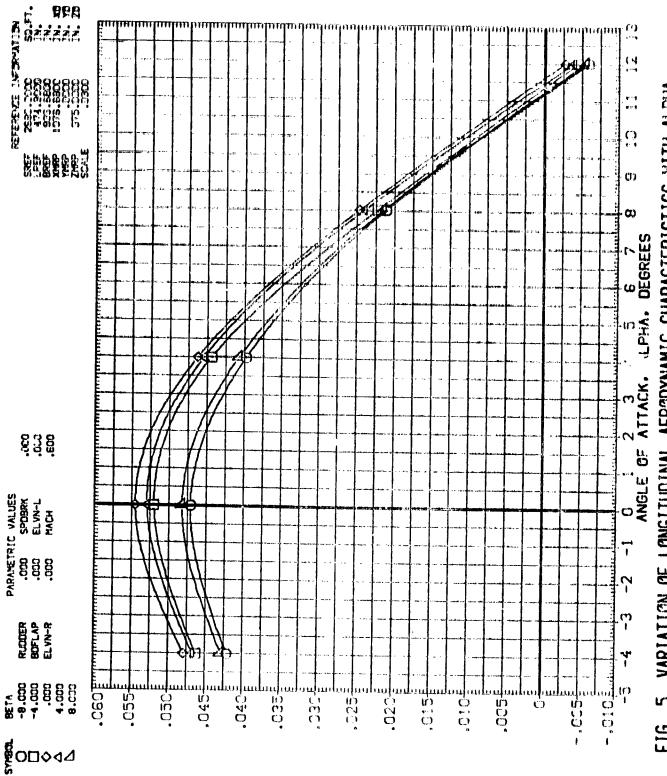
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA O 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES

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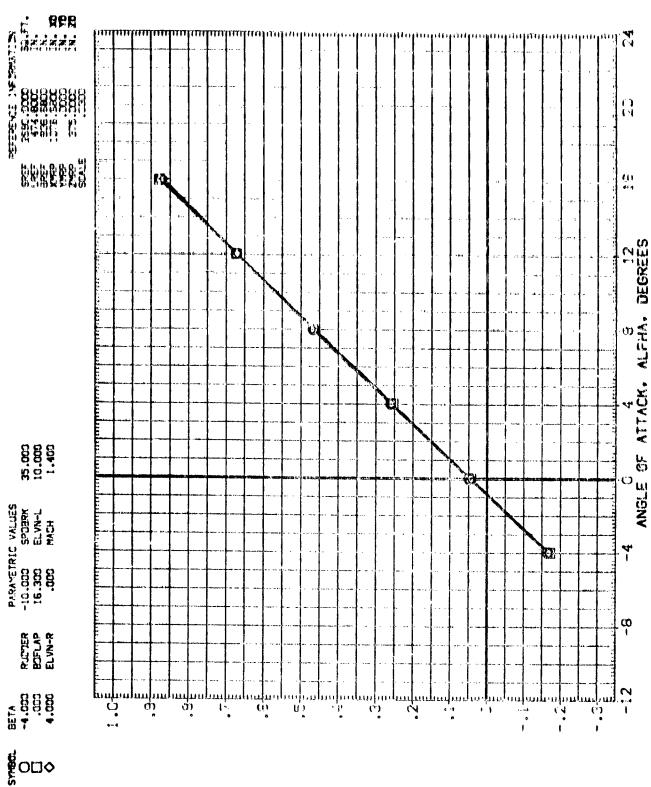
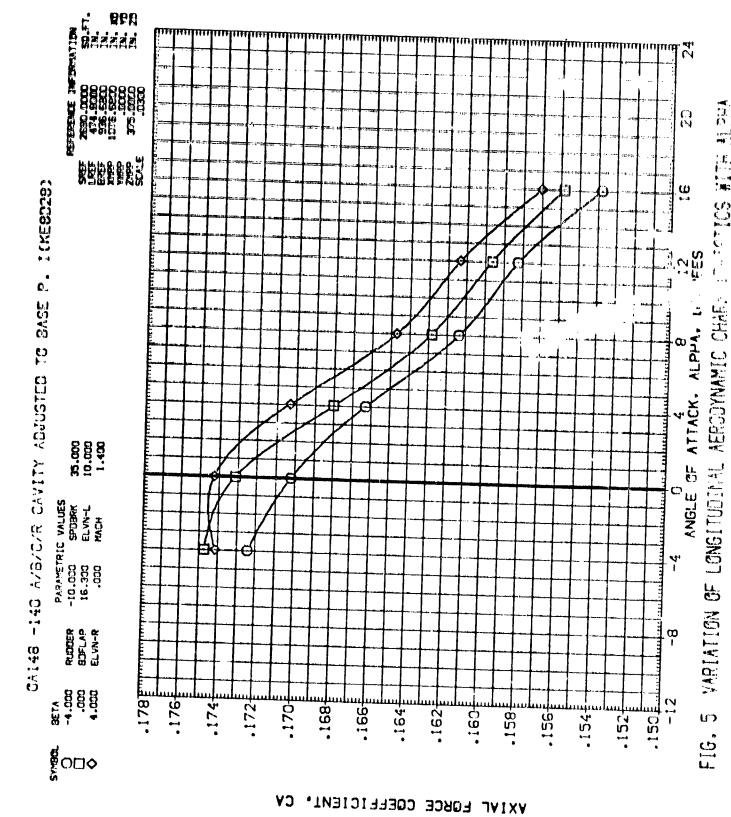
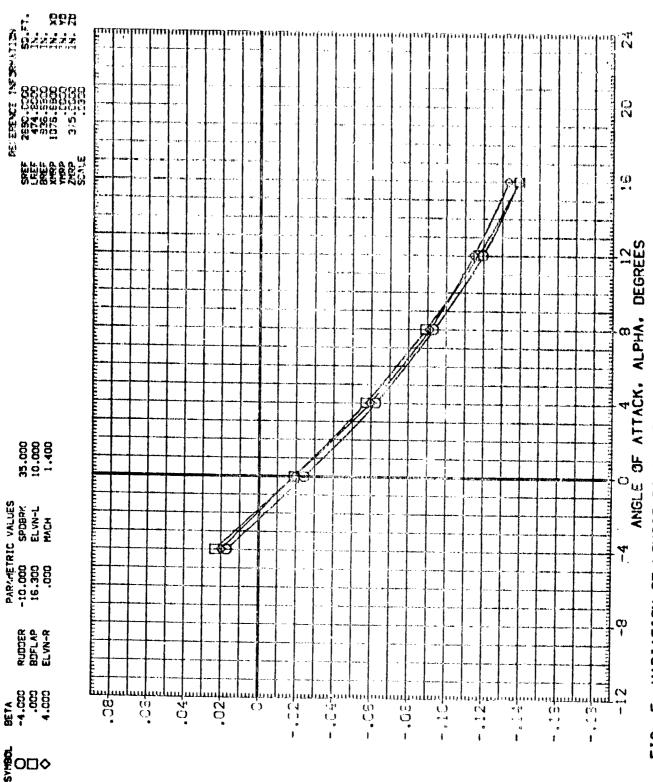


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS FITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

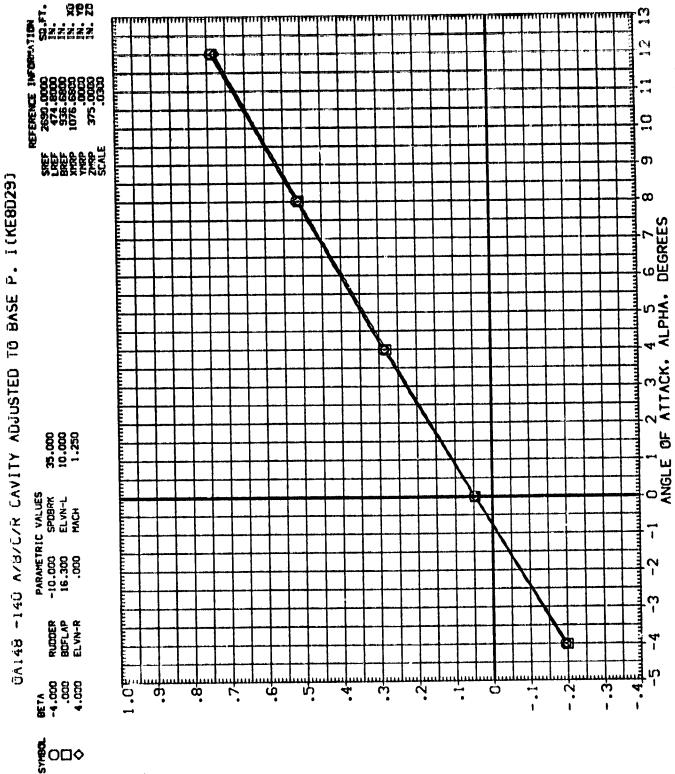
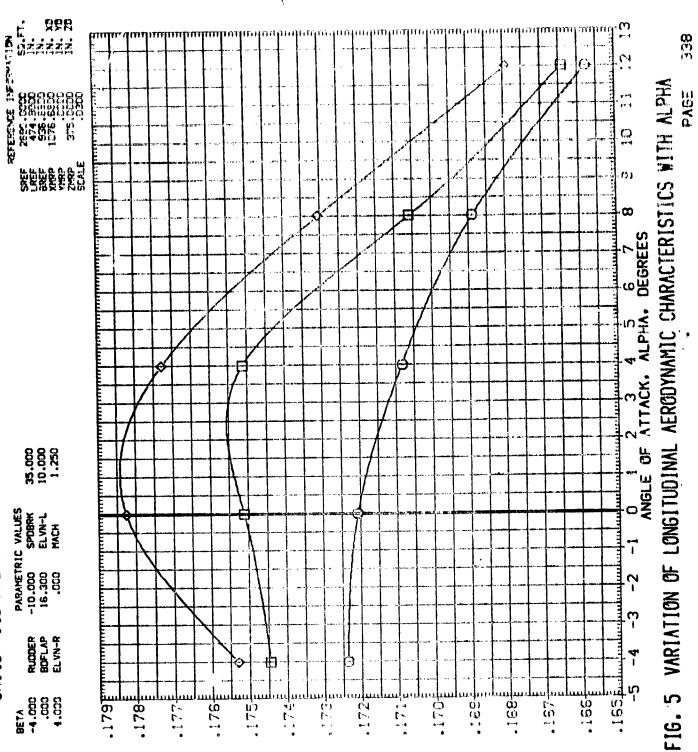


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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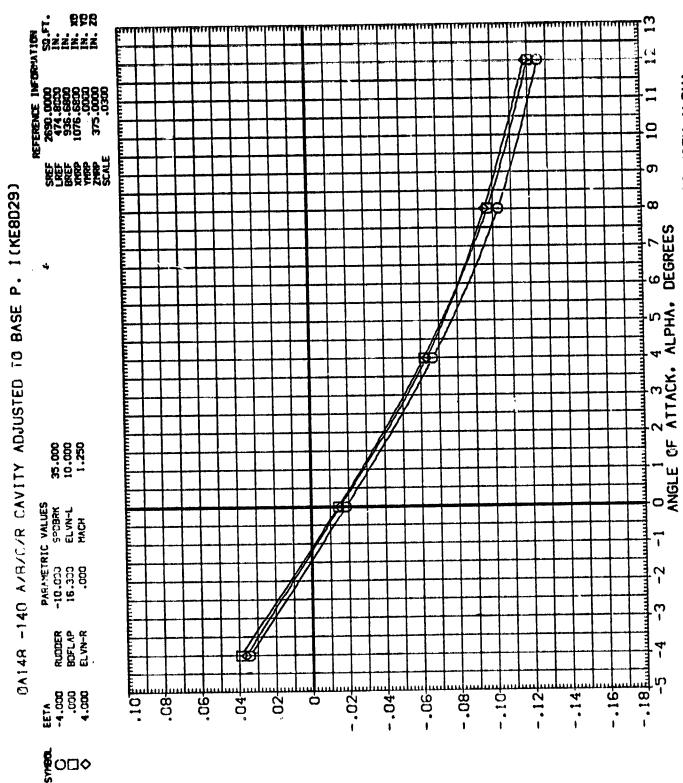


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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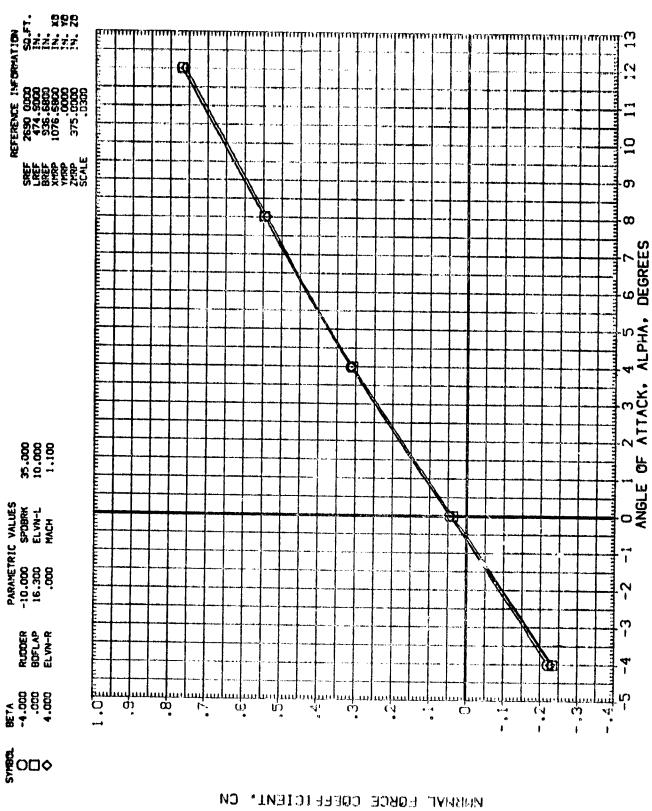
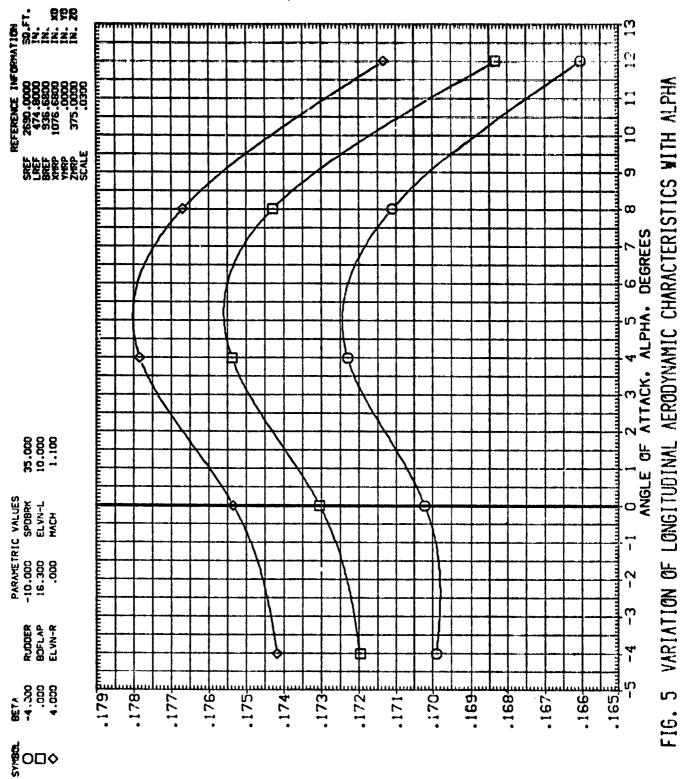


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

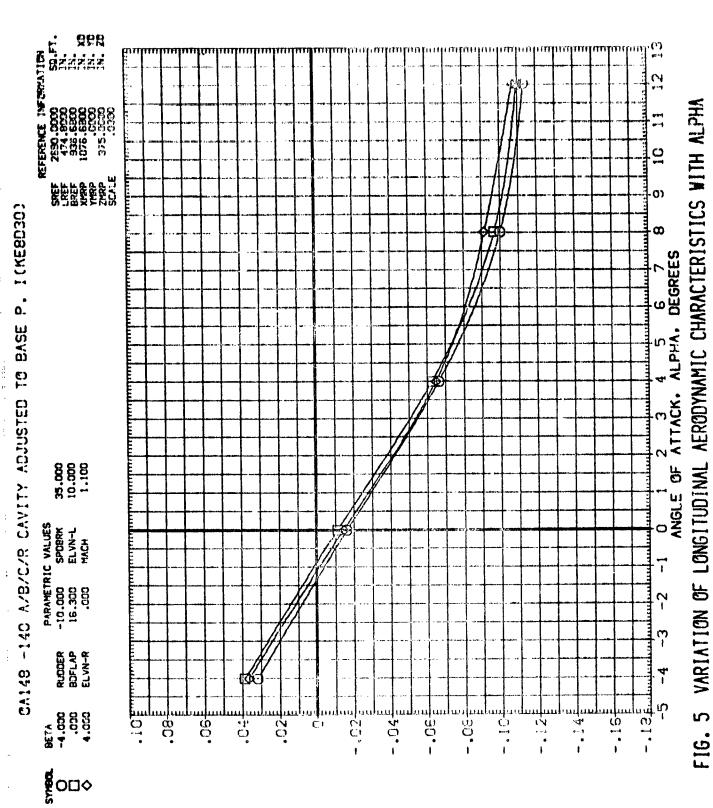
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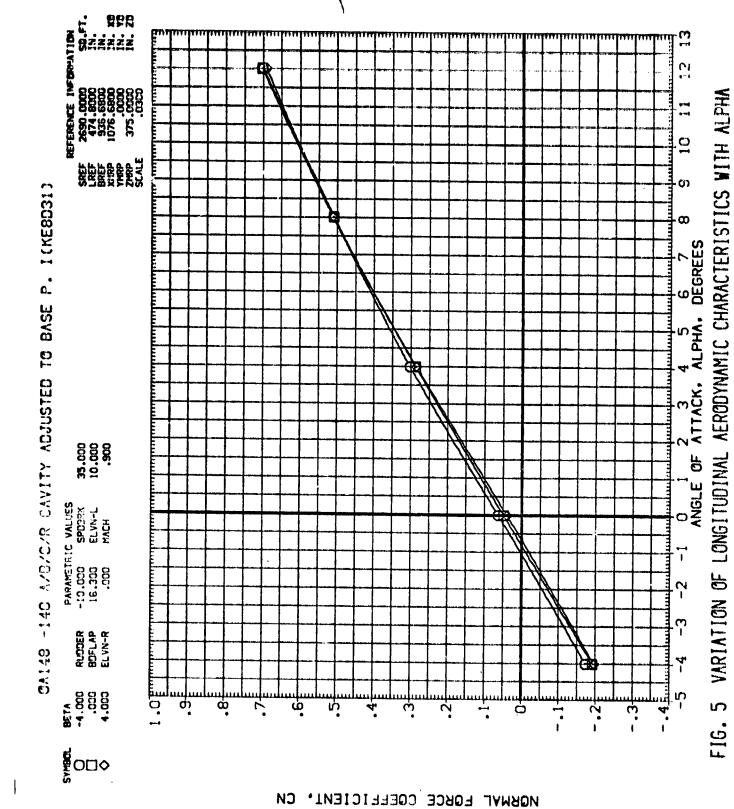
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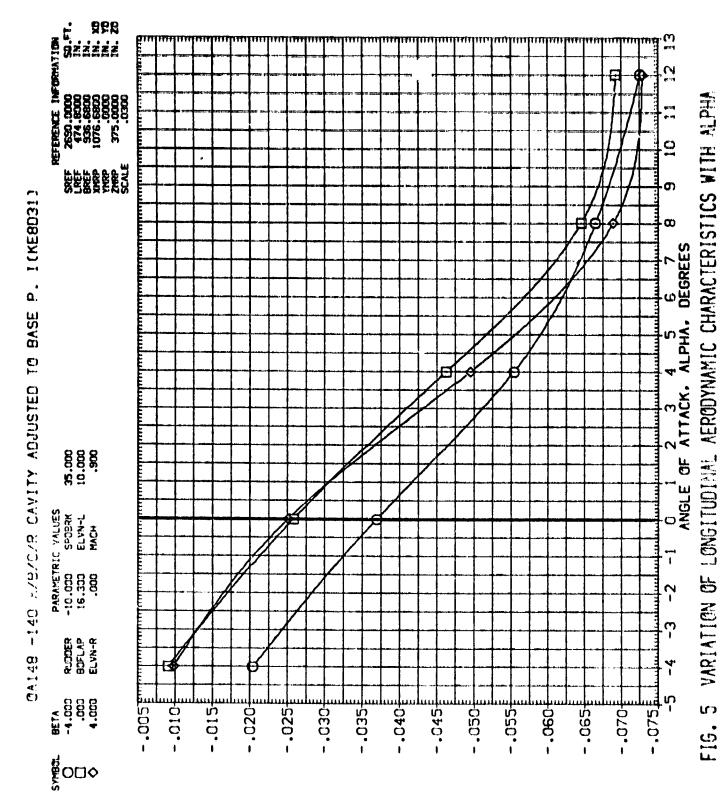


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5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE F16.



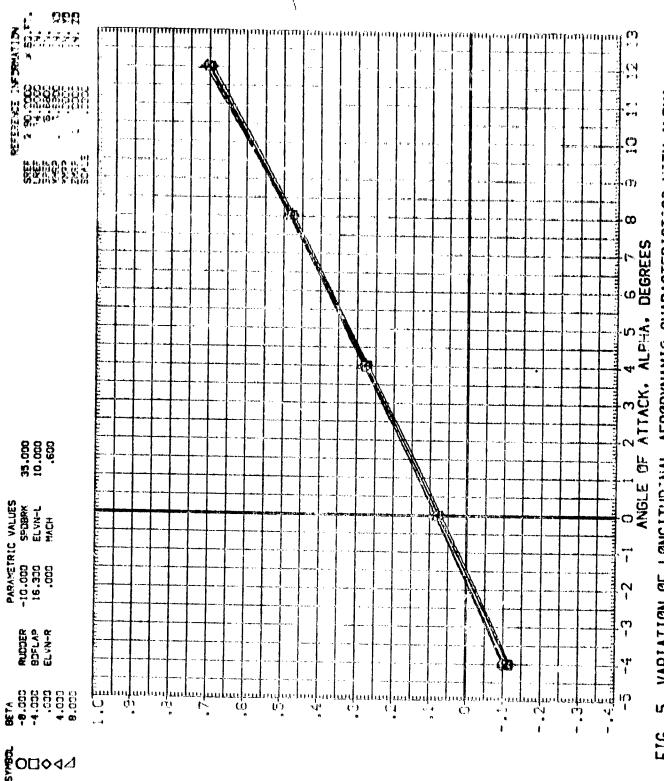


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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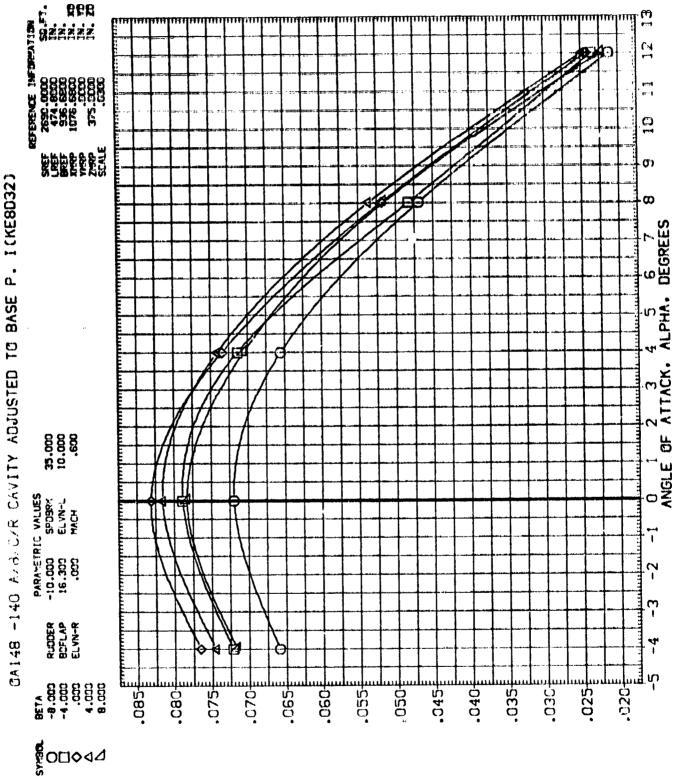
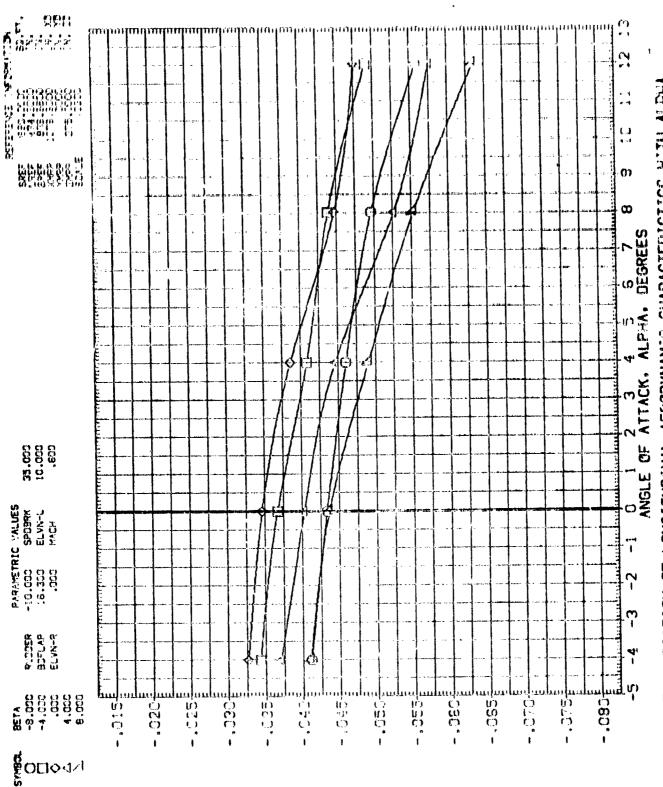


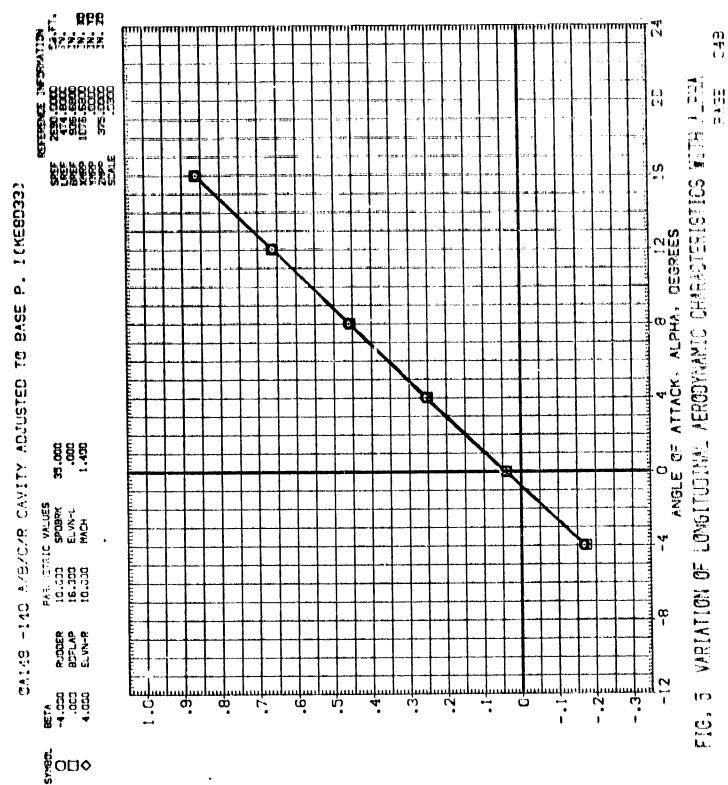
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA 



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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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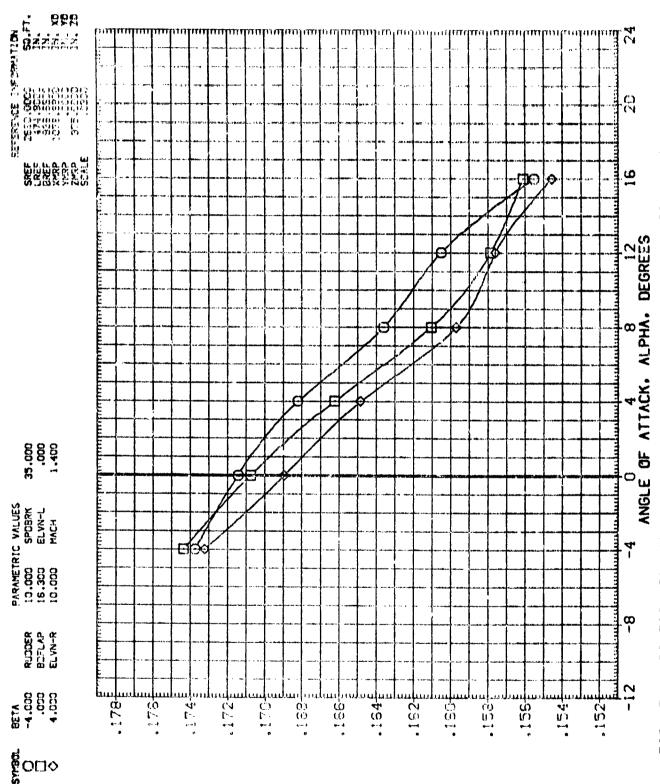
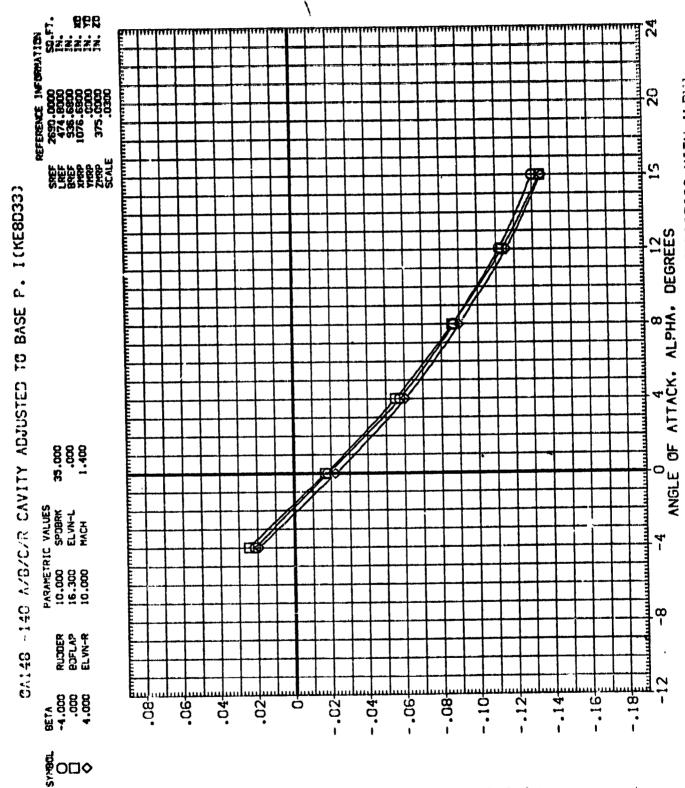


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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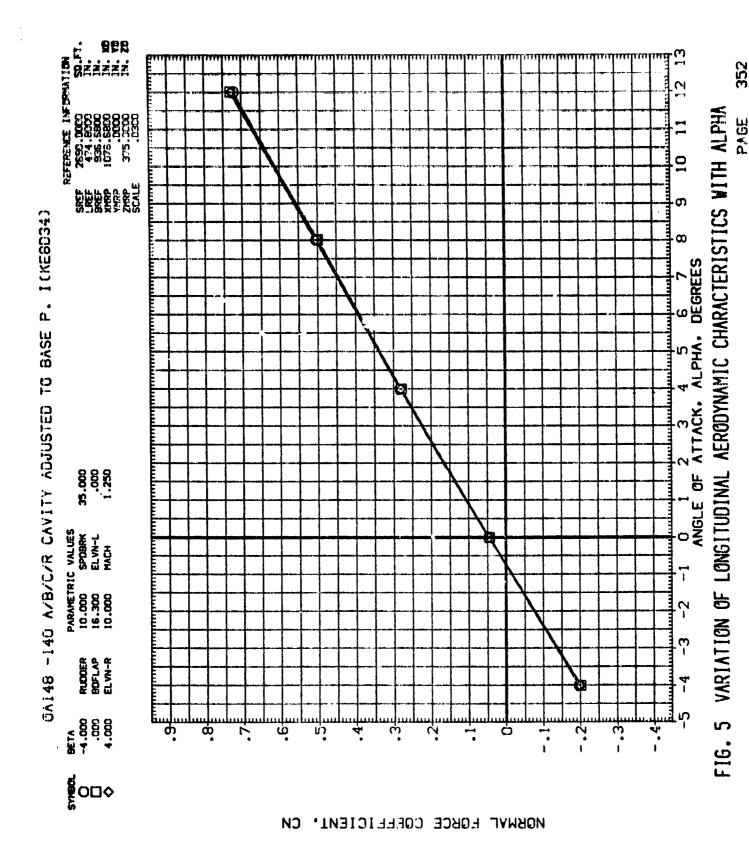


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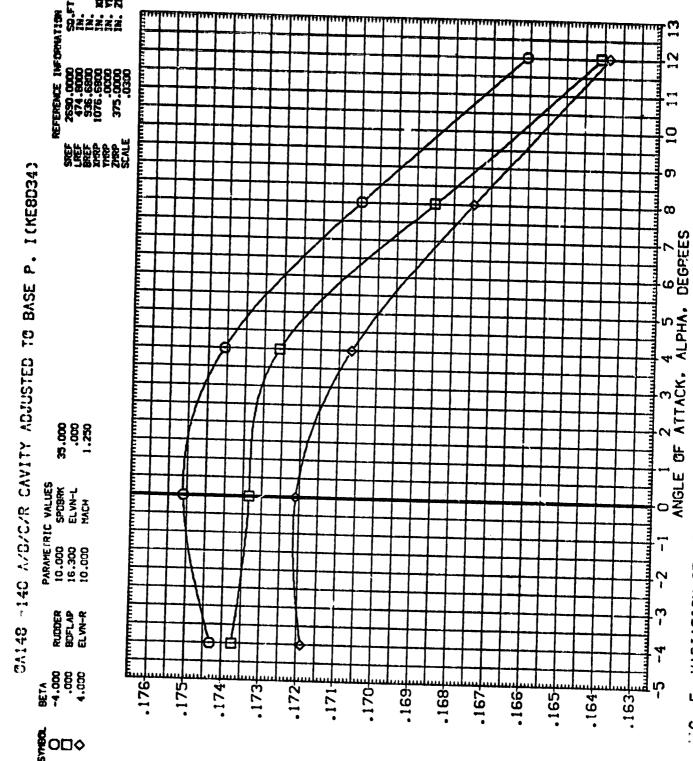
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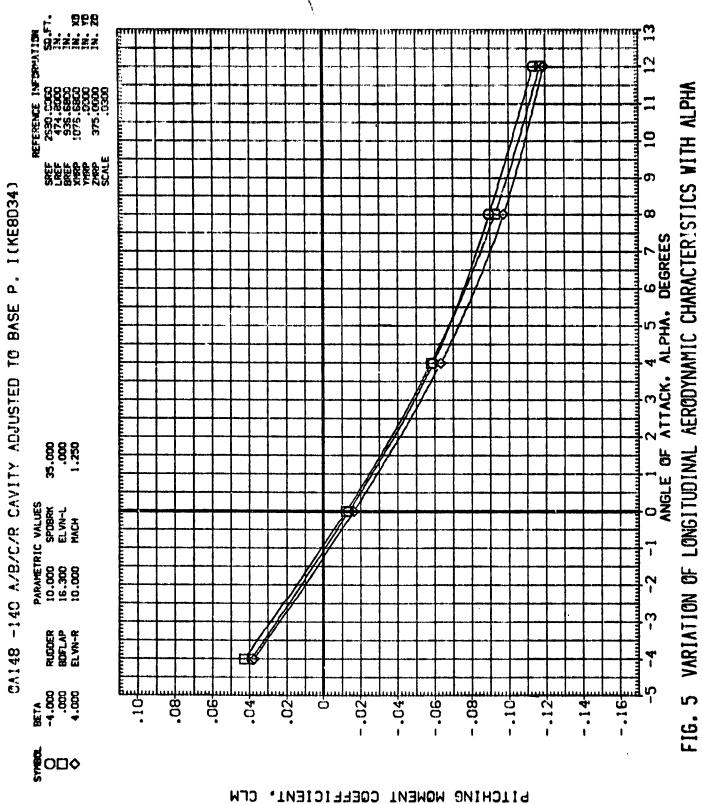


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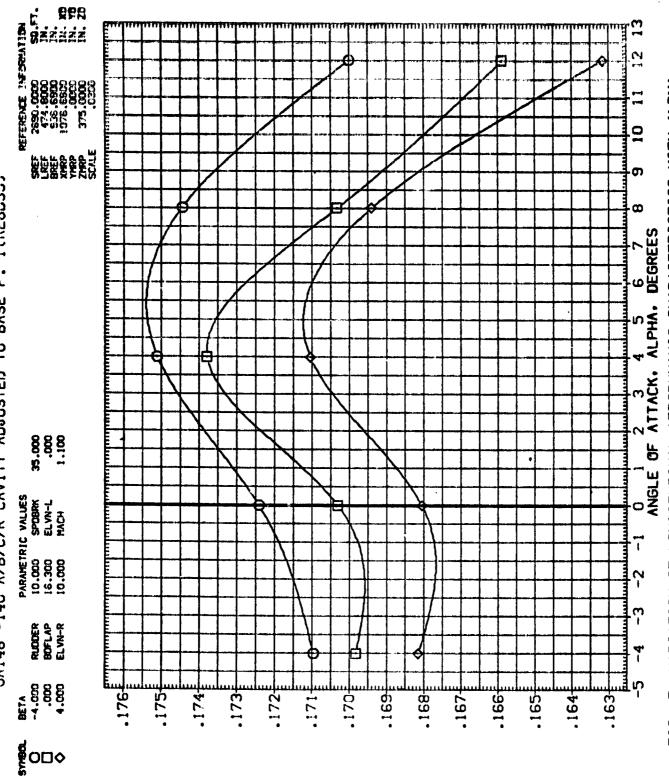
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NORMAL FORCE COEFFICIENT,

TARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA FIG. 5

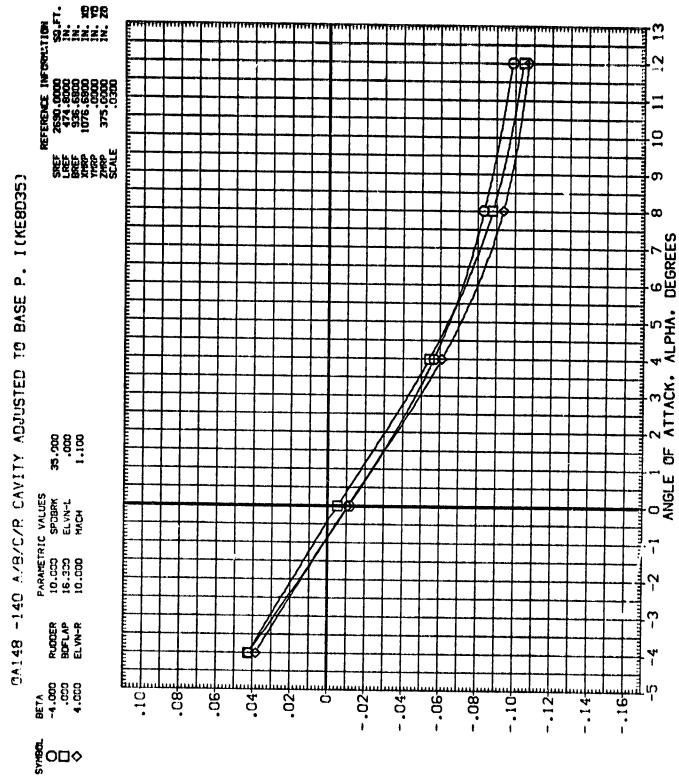


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

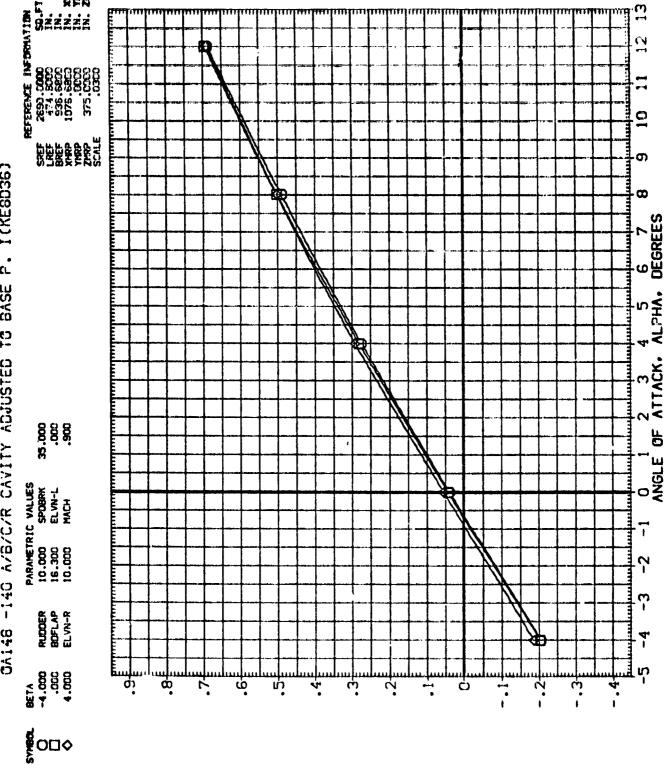
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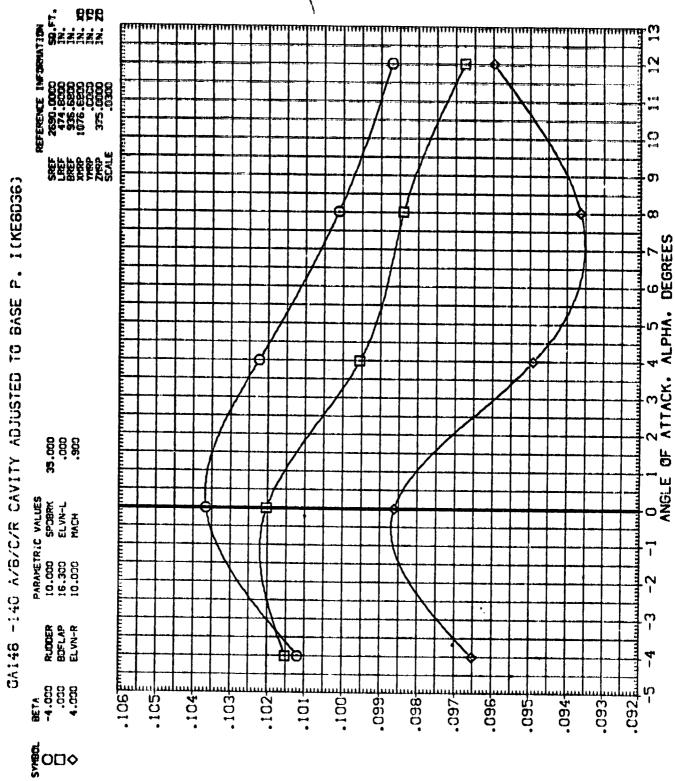
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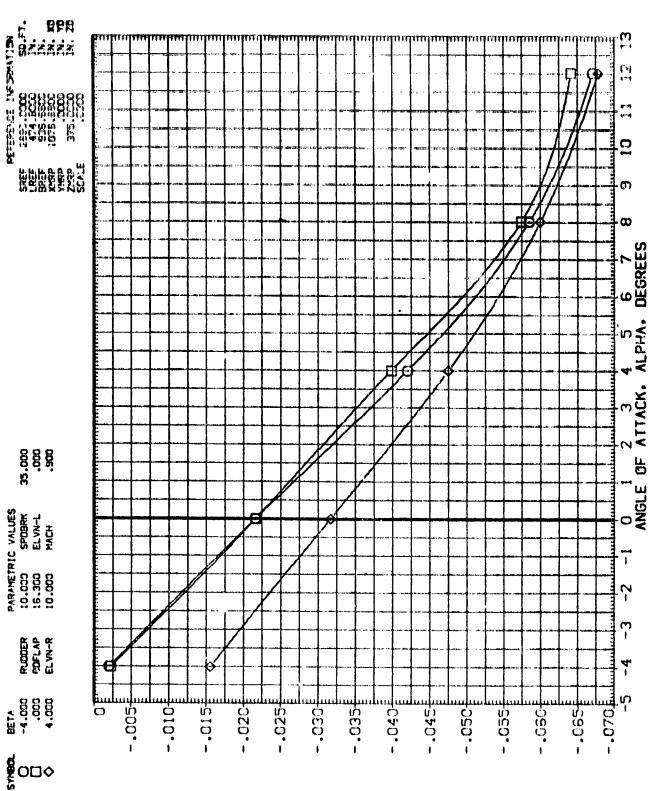
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



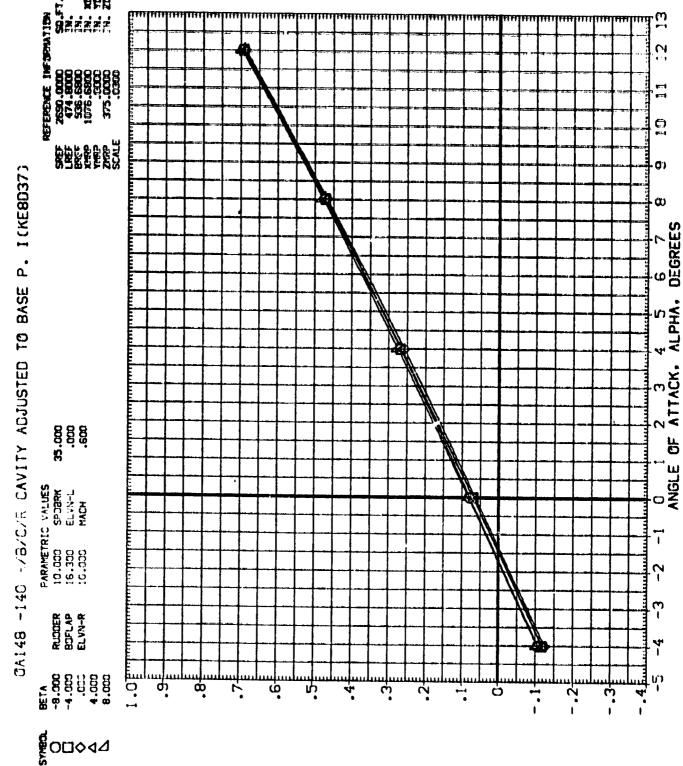
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



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VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

Fig. 5

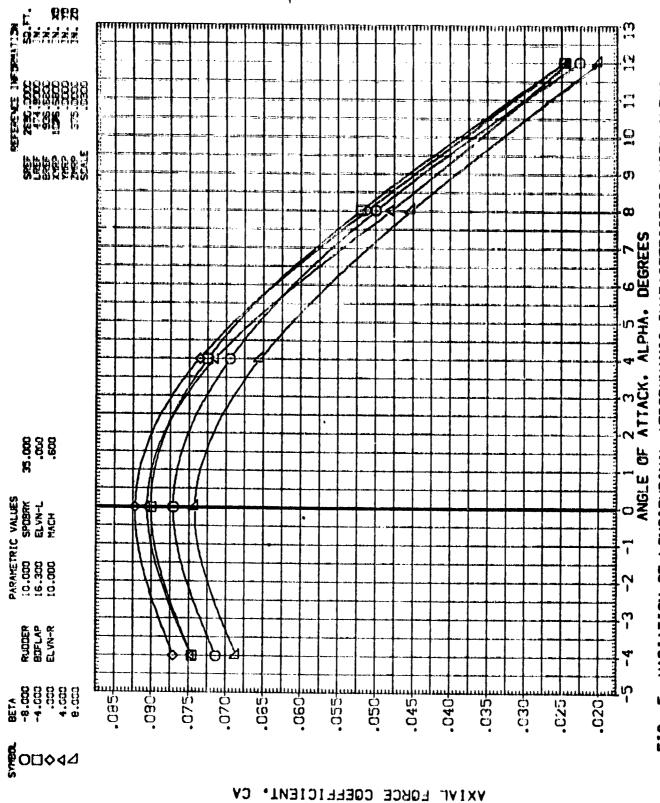
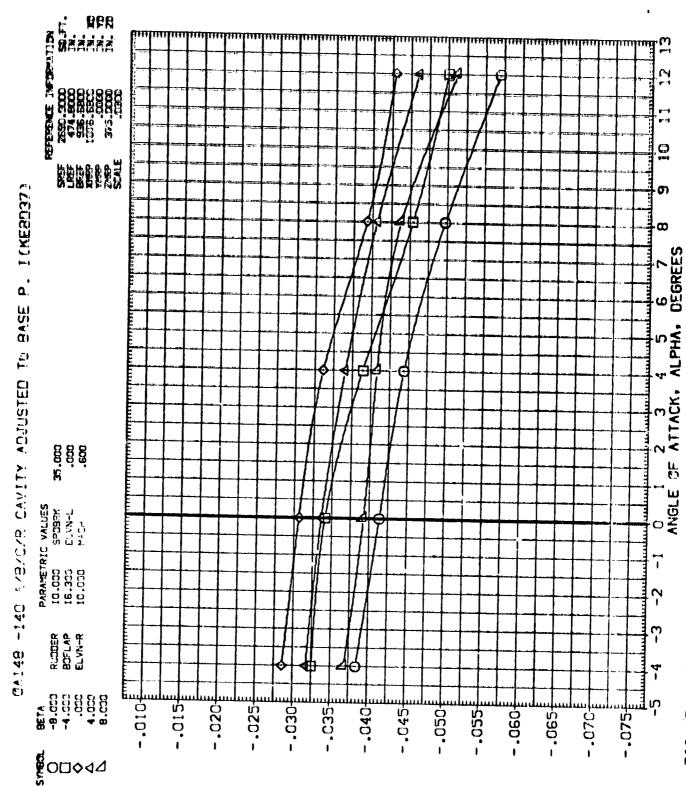


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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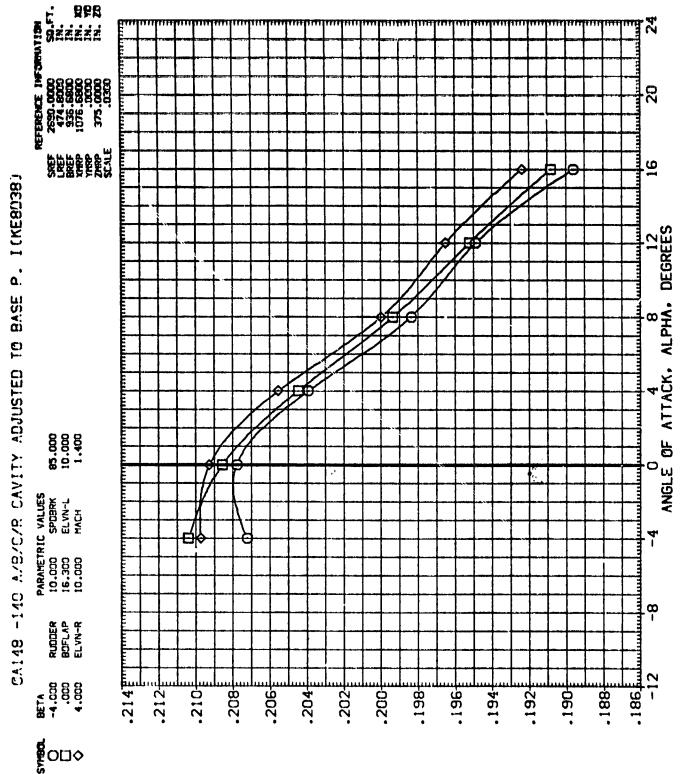
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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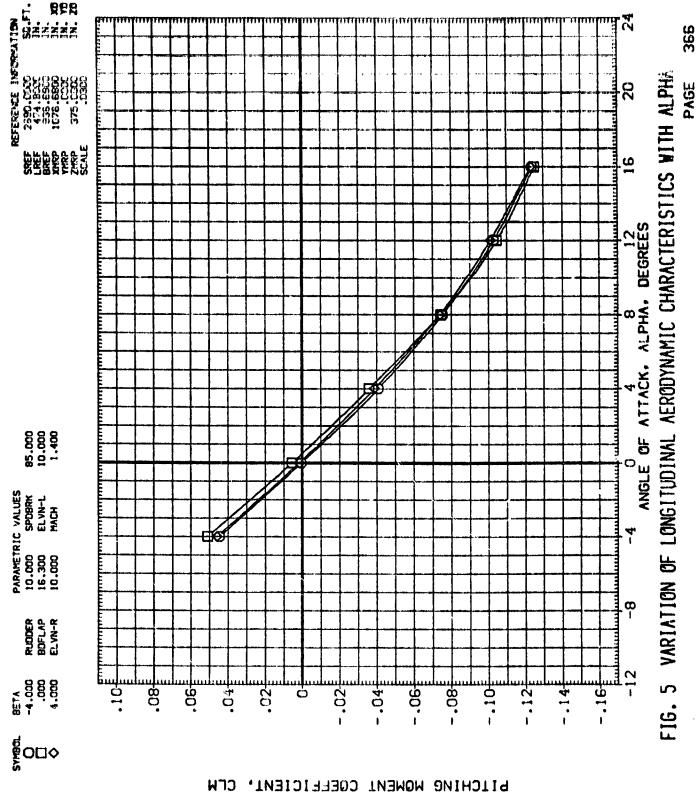
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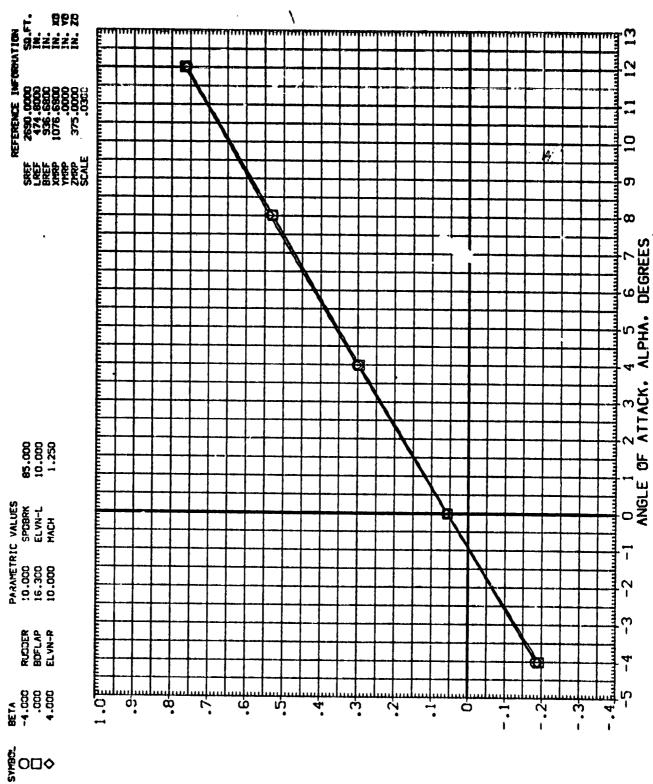


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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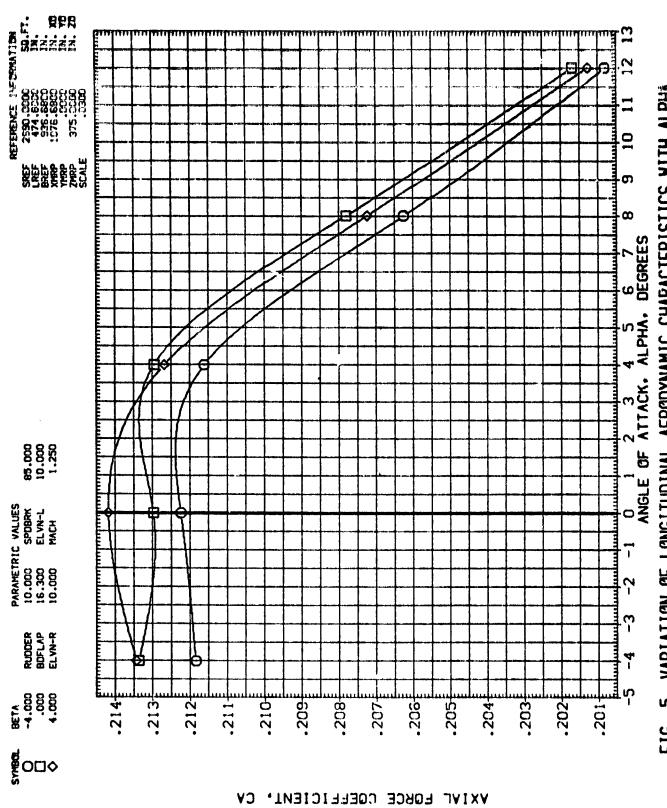


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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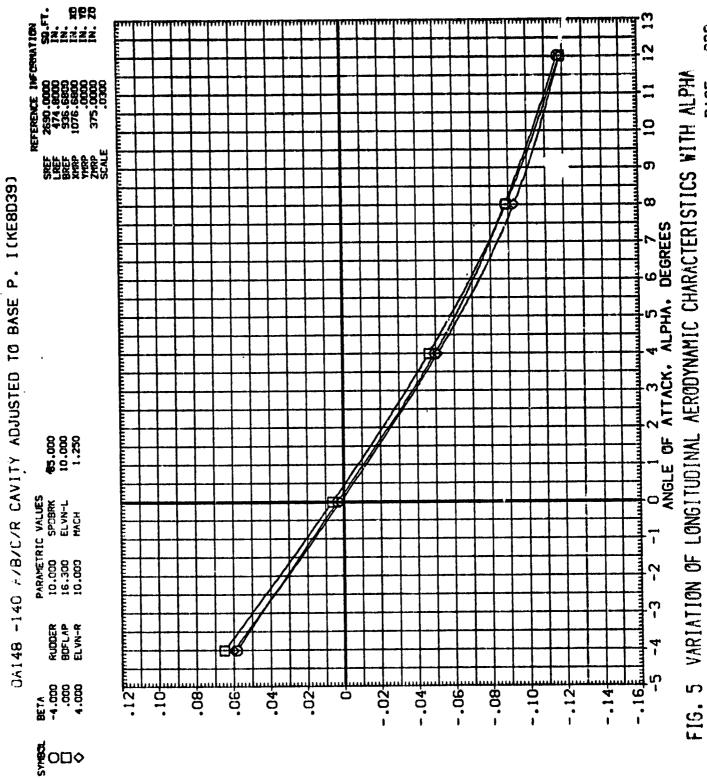
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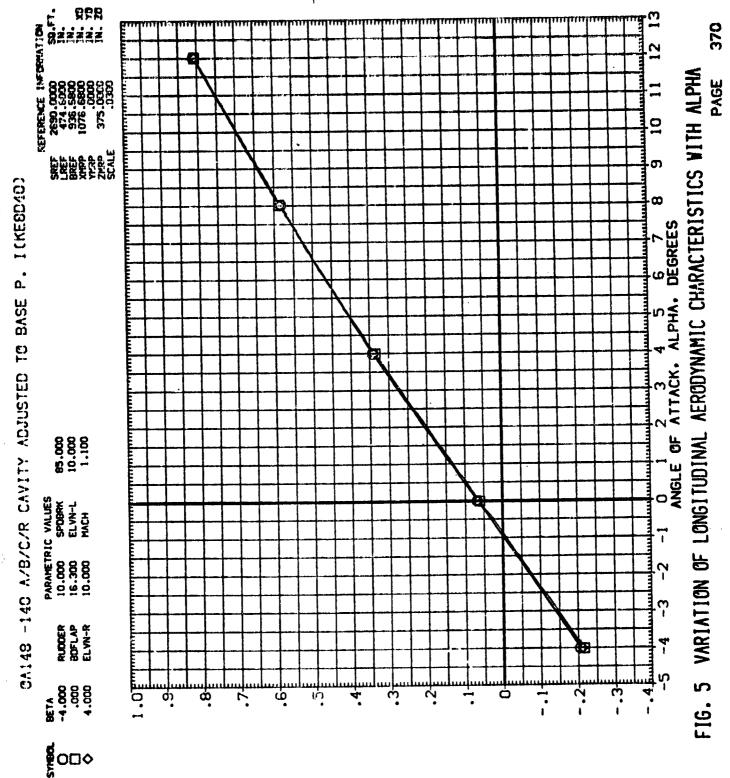


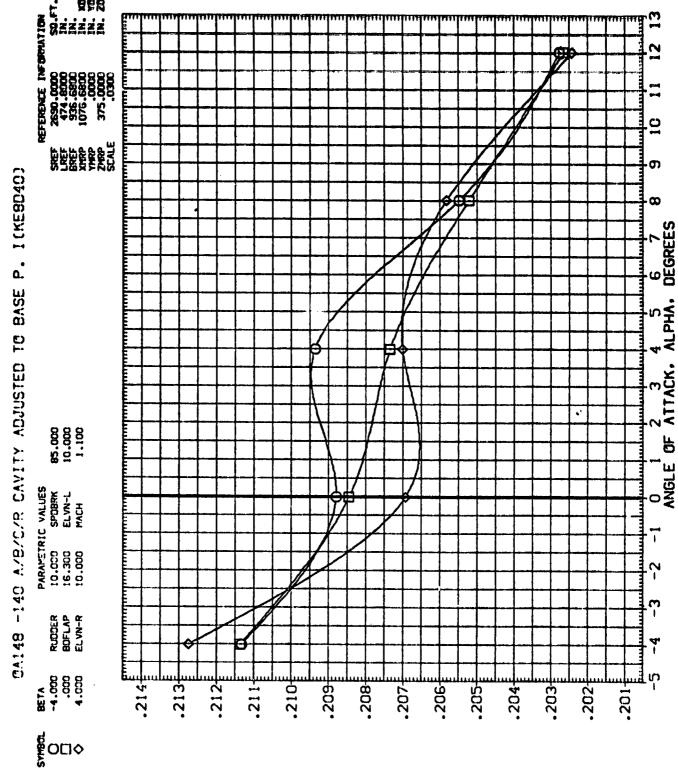
VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS VITH ALPHÁ F16. 5

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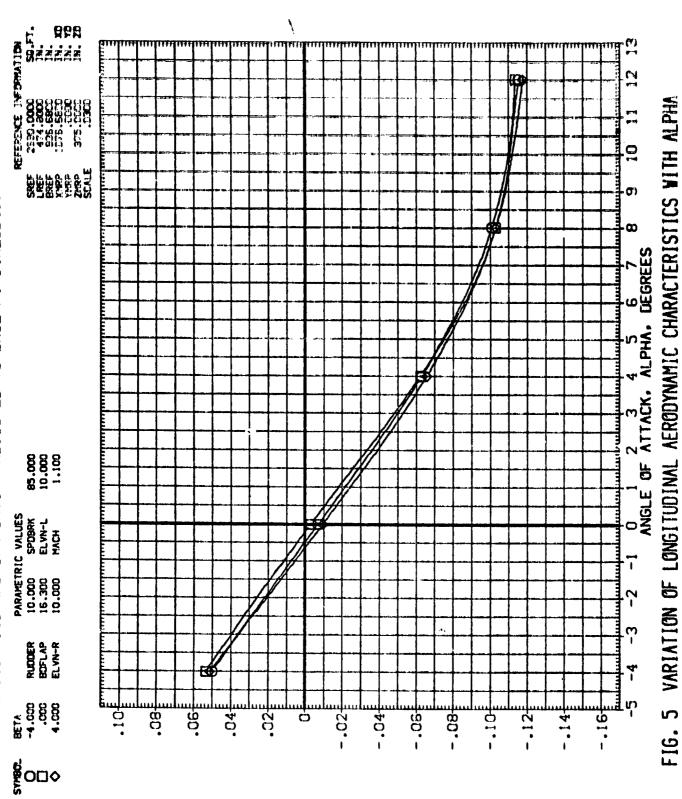


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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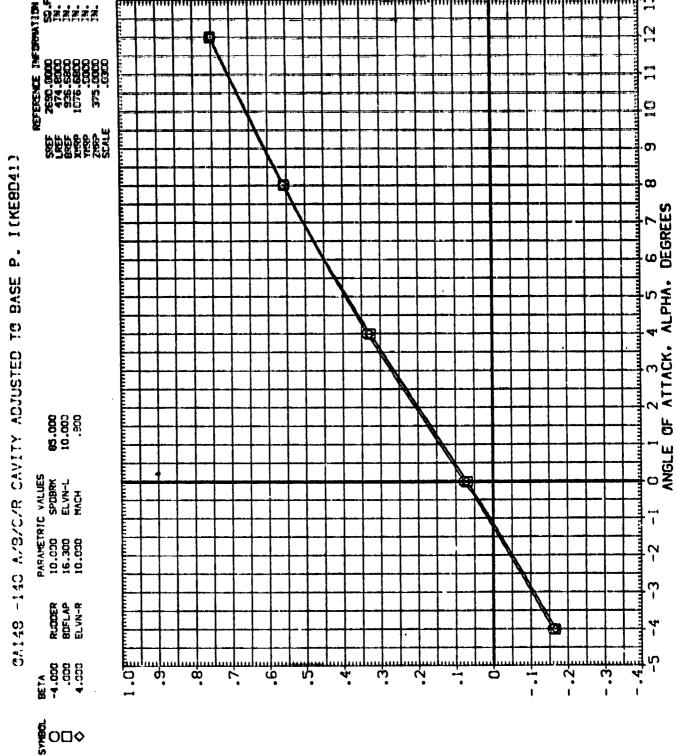


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FIG. 5



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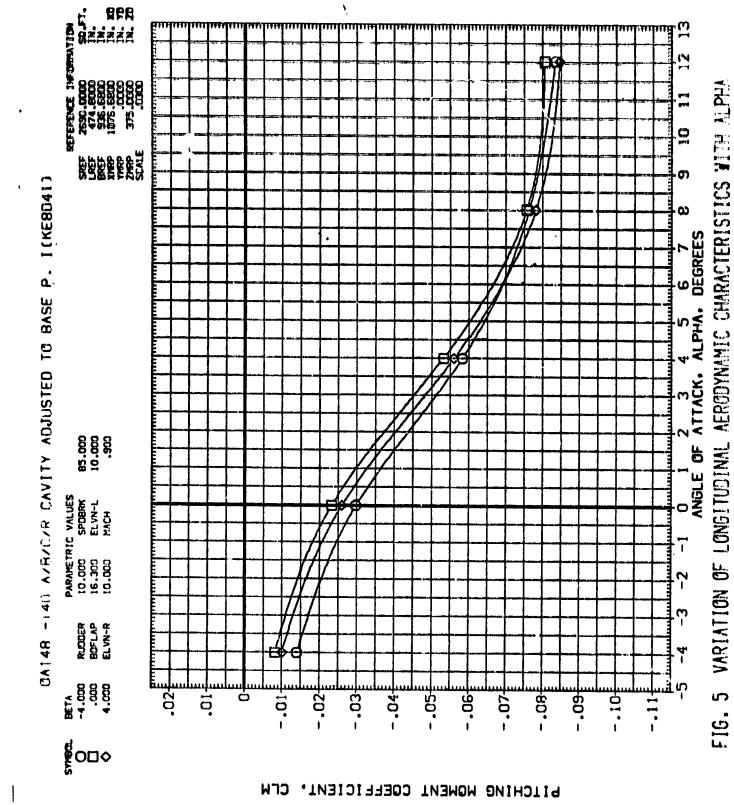
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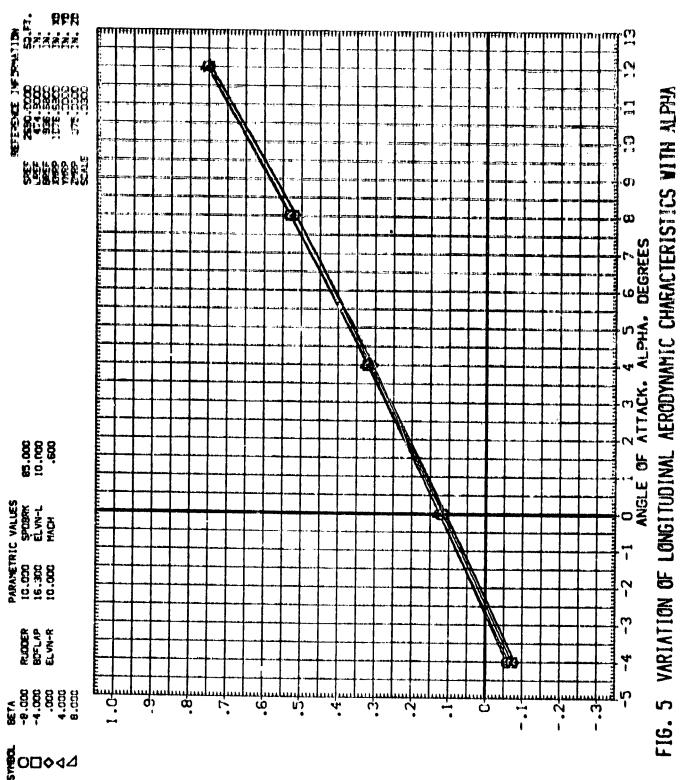
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS VITH ALPHA

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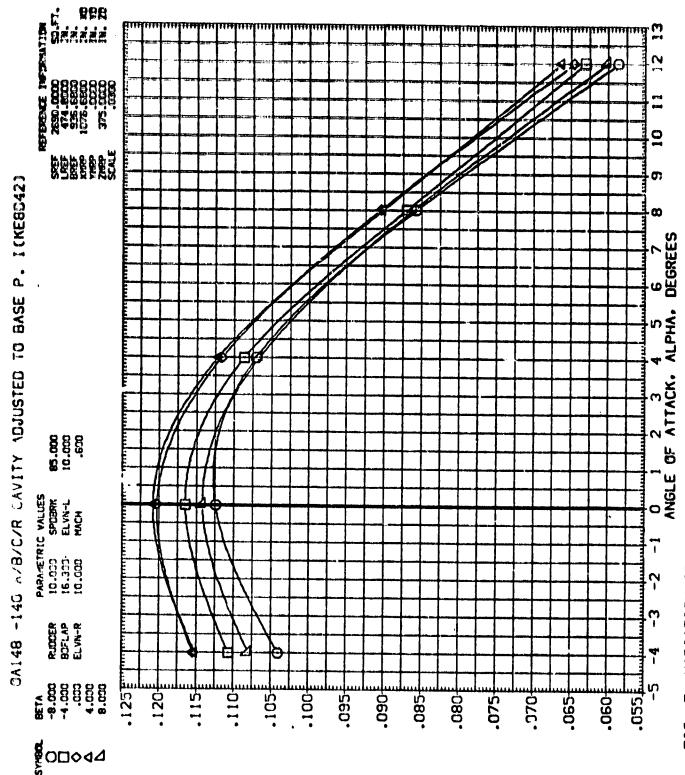
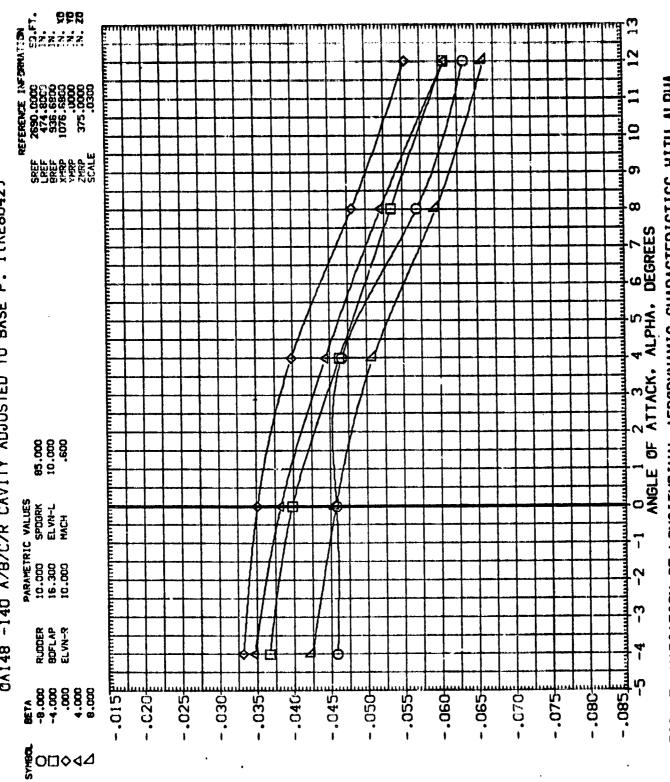
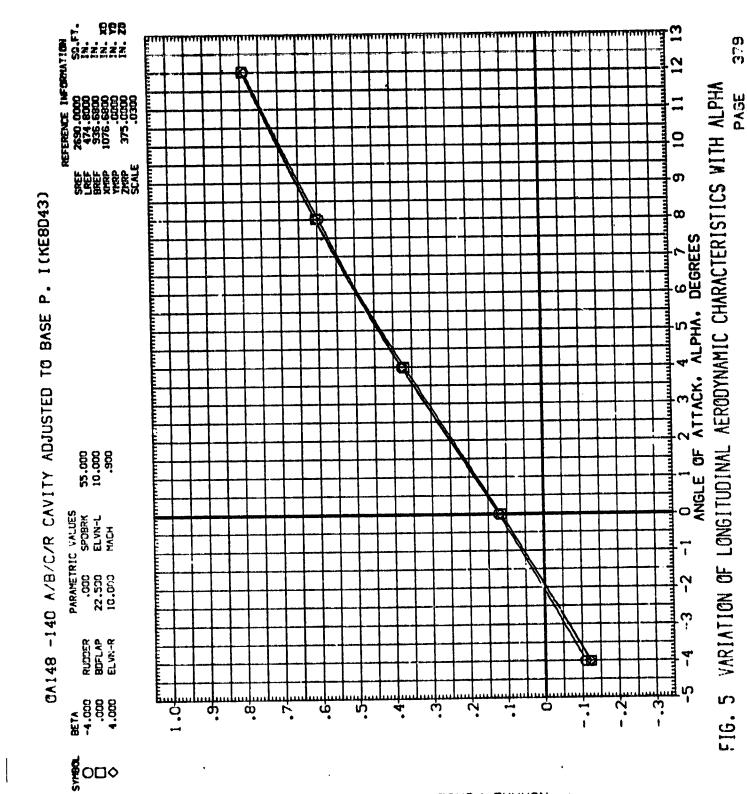


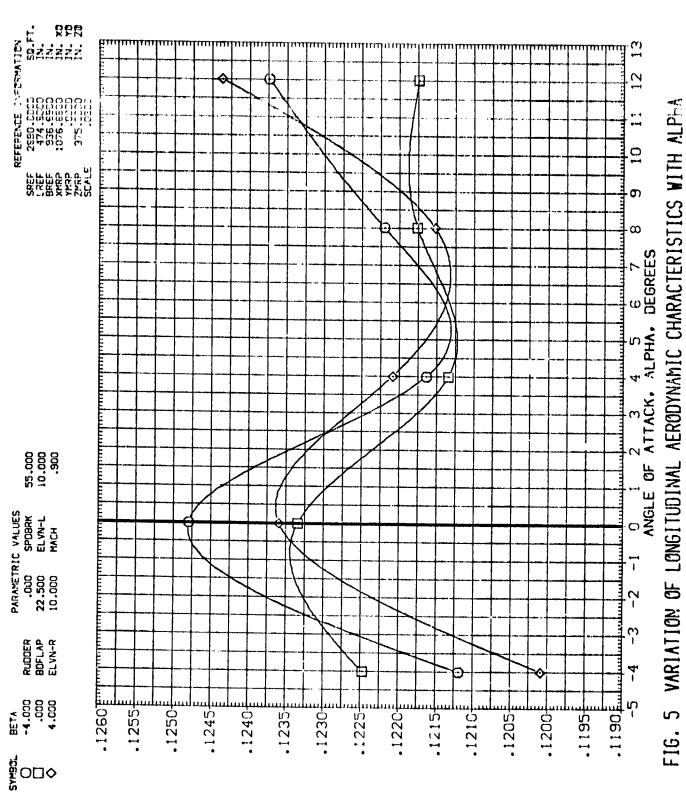
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



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VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE F16. 5

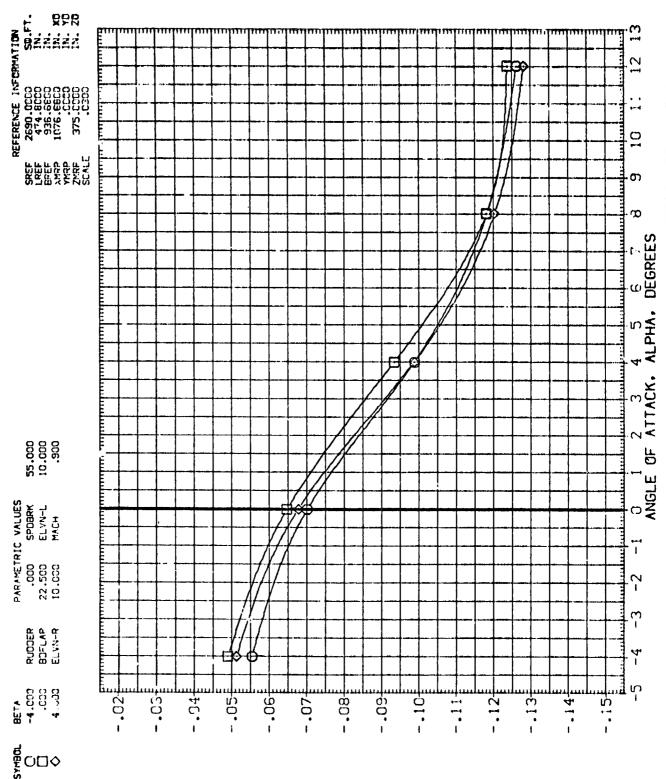




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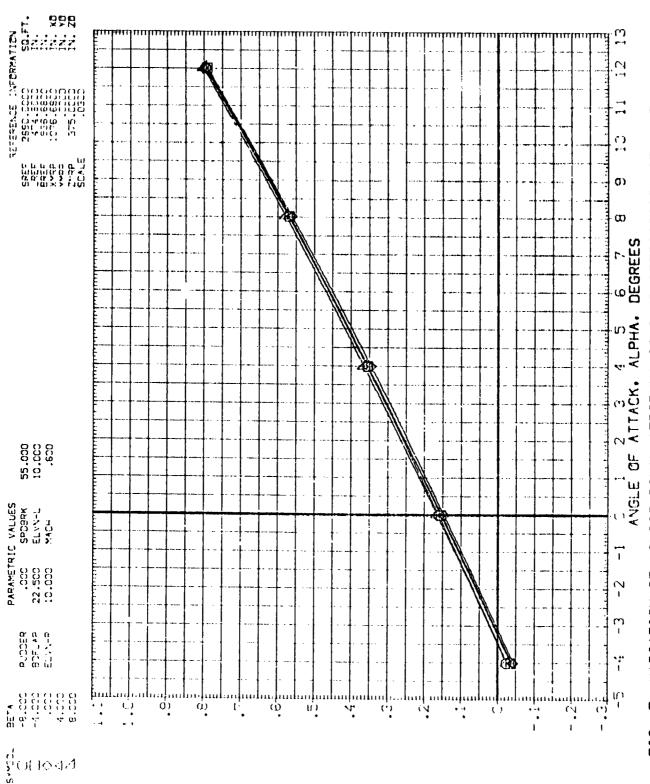
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

PAGE 381



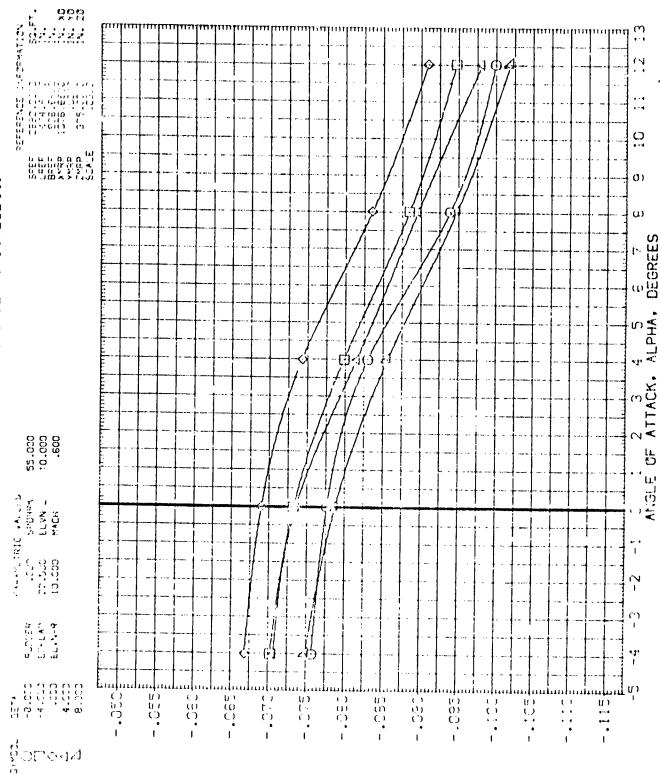
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VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA ഗ . 10.

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VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA FIG. 5

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FIG. 5 VARIATION OF LONSITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

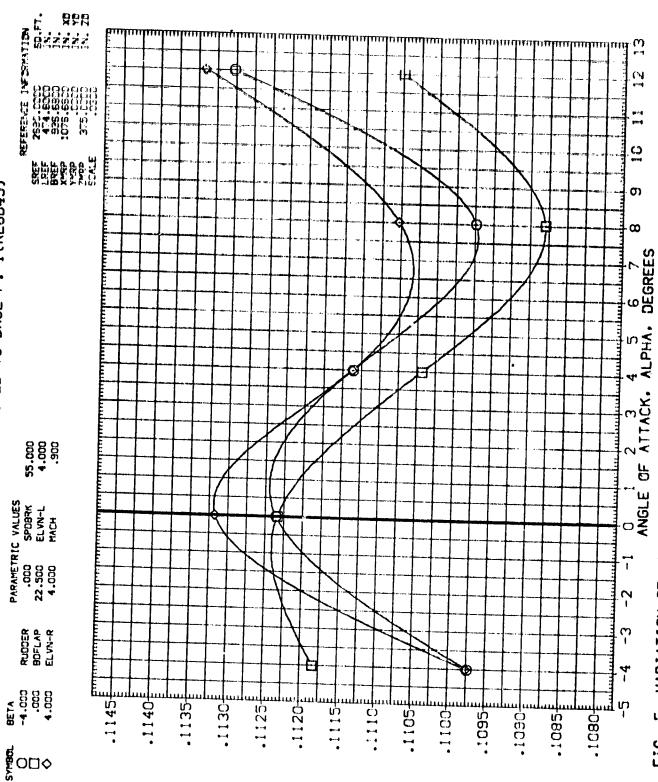
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VARIATION OF LONGITUDINAL "ERODYNAMIC CHARACTERISTICS WITH ALPHA FIG. 53

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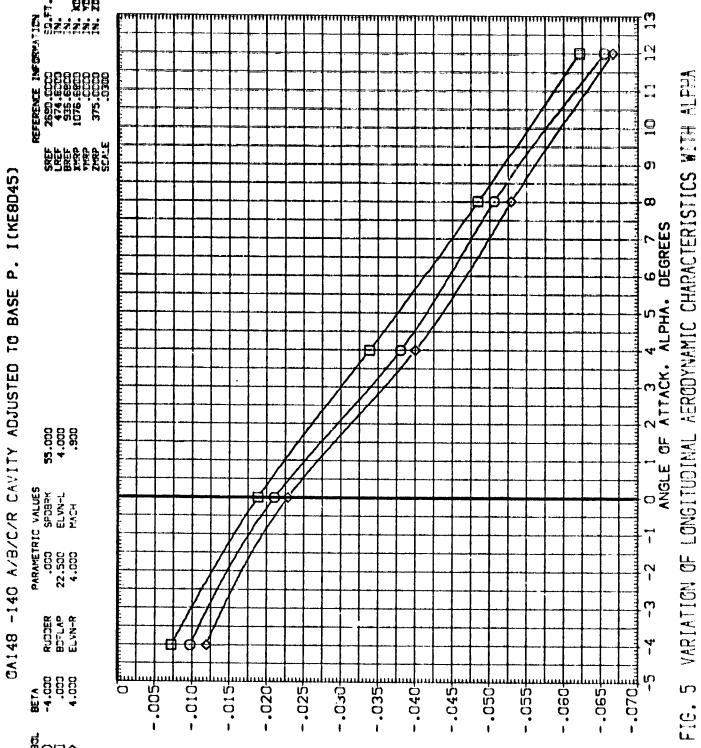


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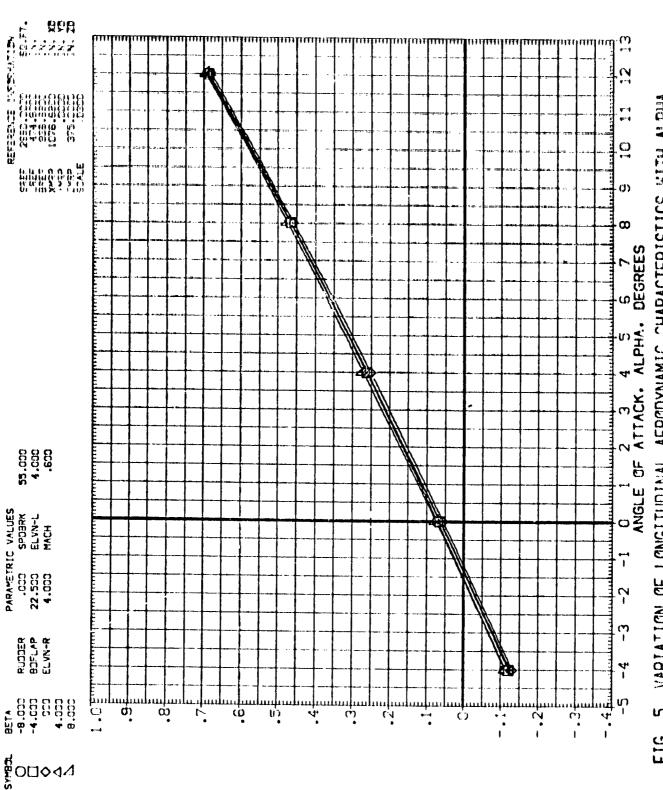
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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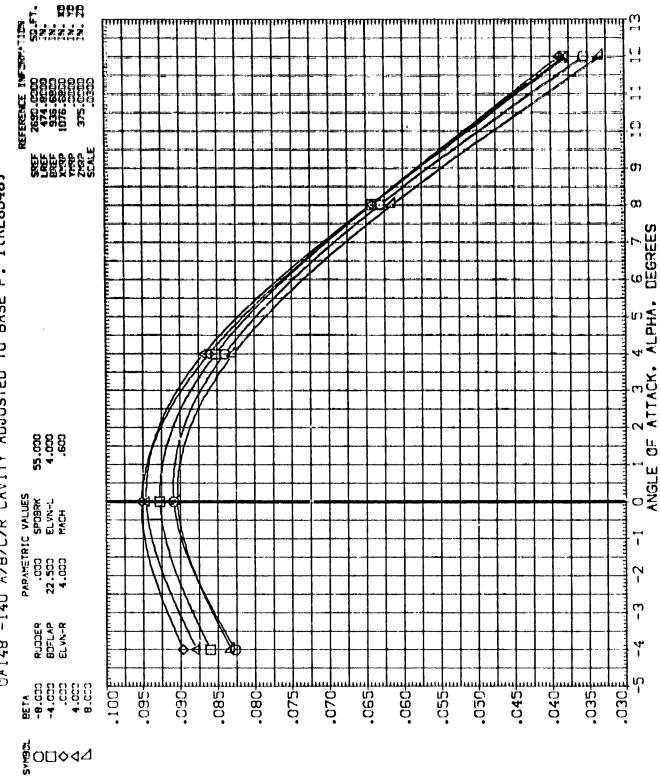
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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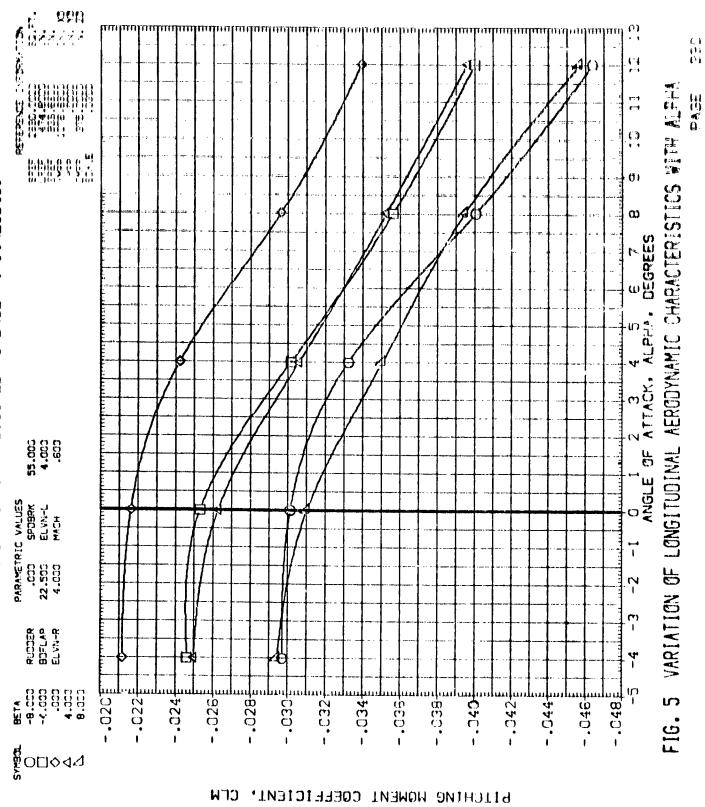


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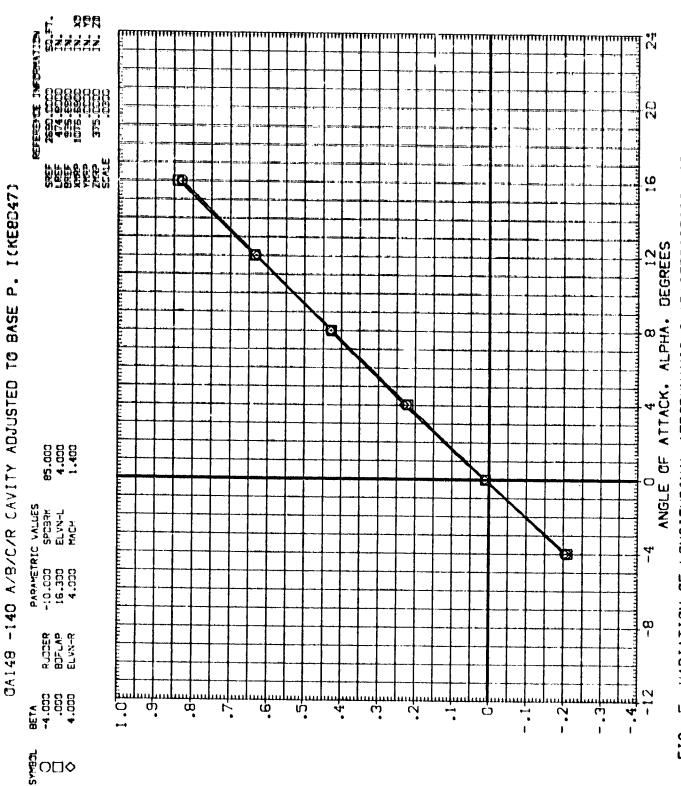
VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA FIG. 5

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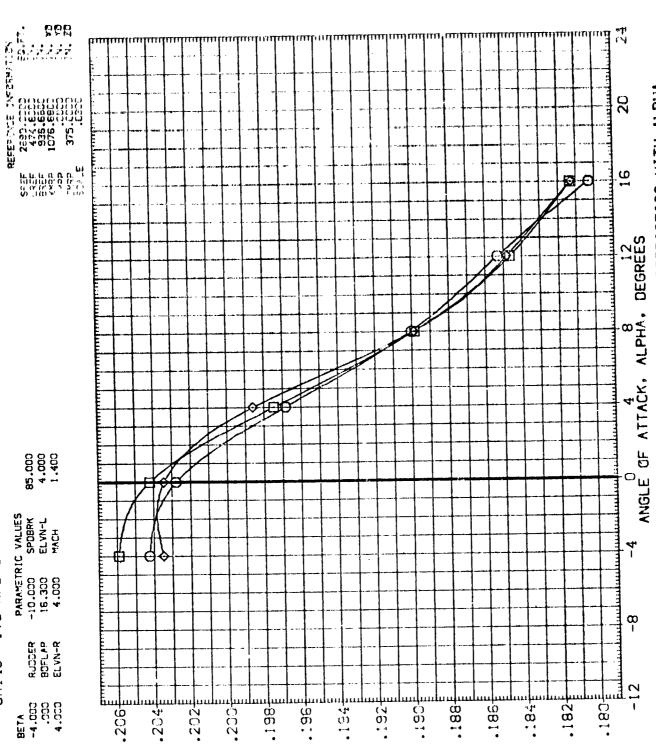


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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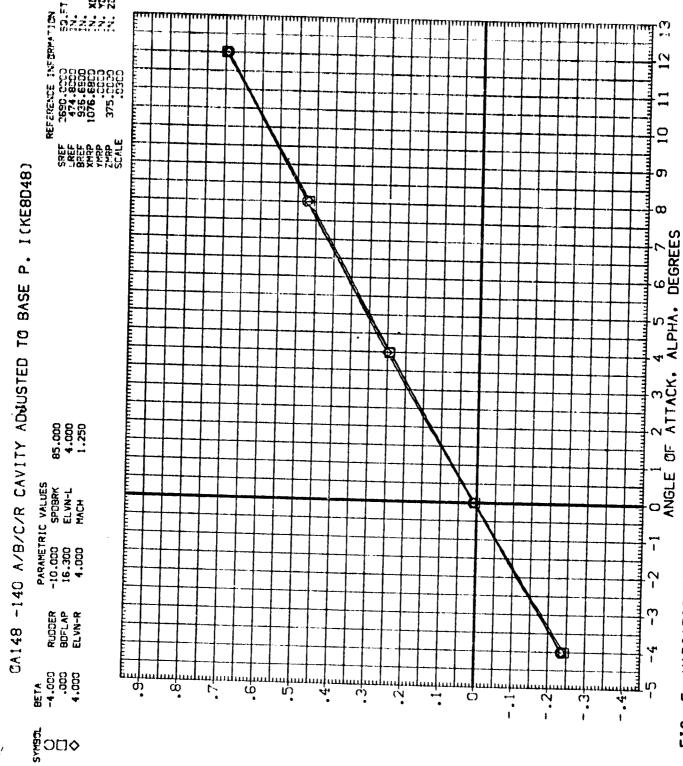
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362 FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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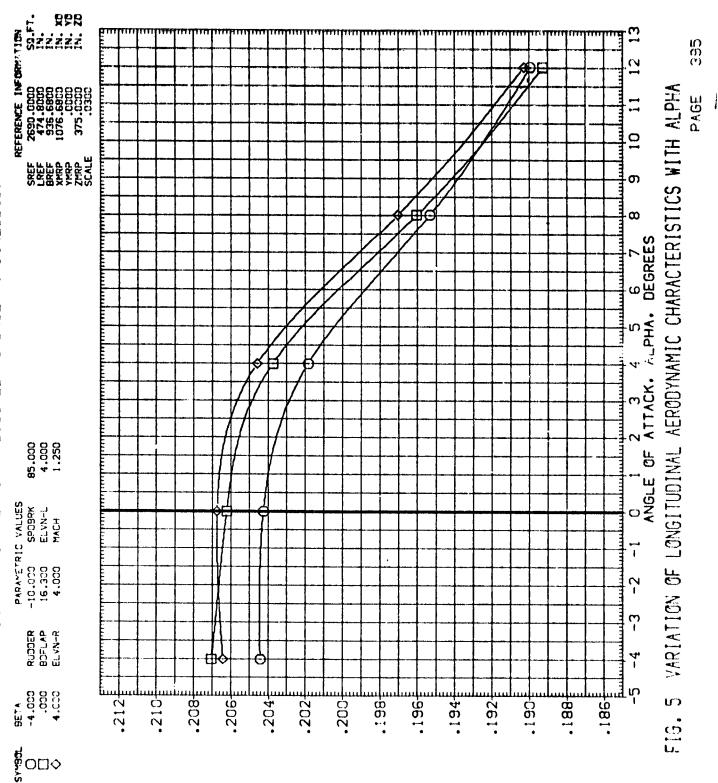


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

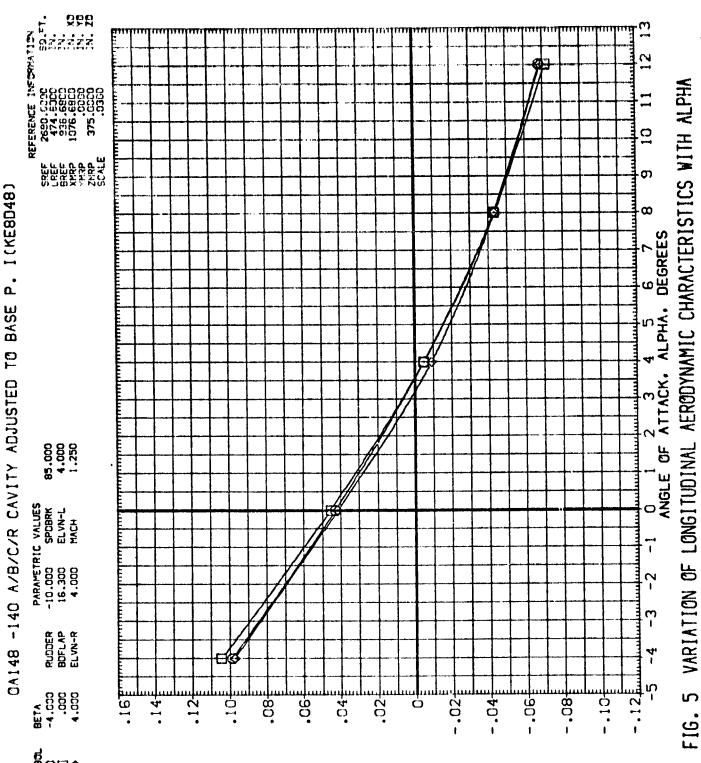
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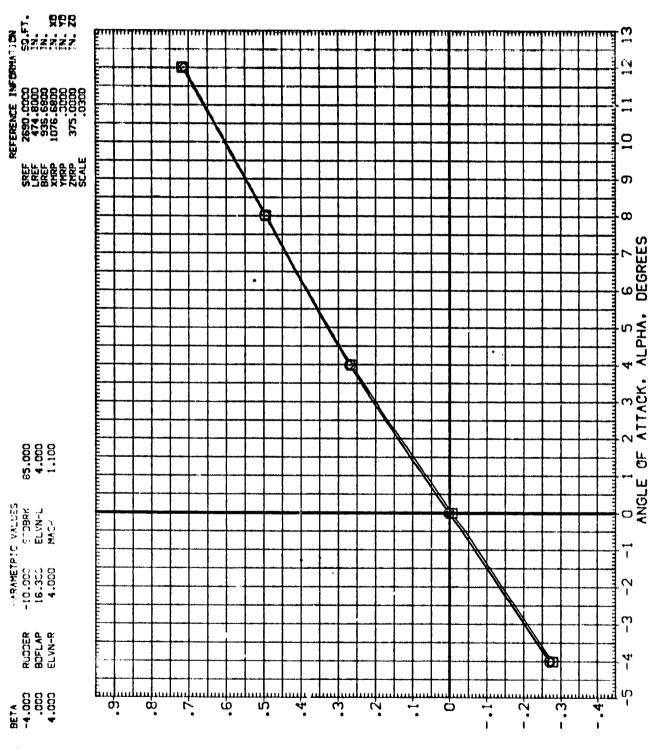
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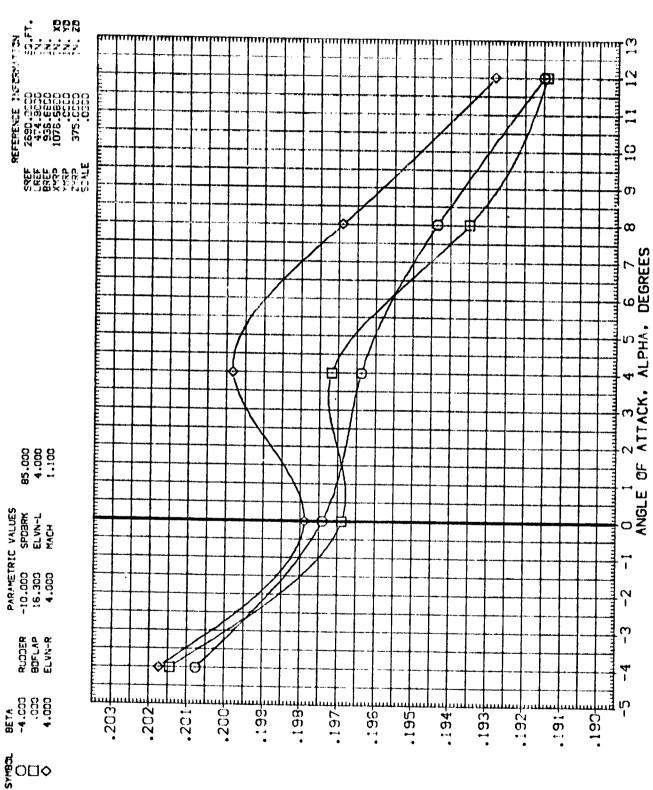


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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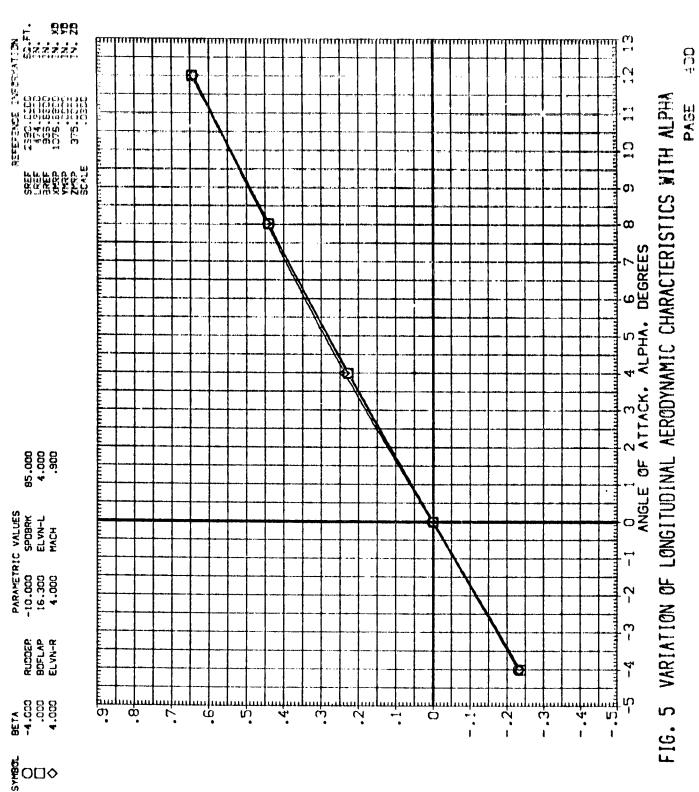
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA 10 O 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES

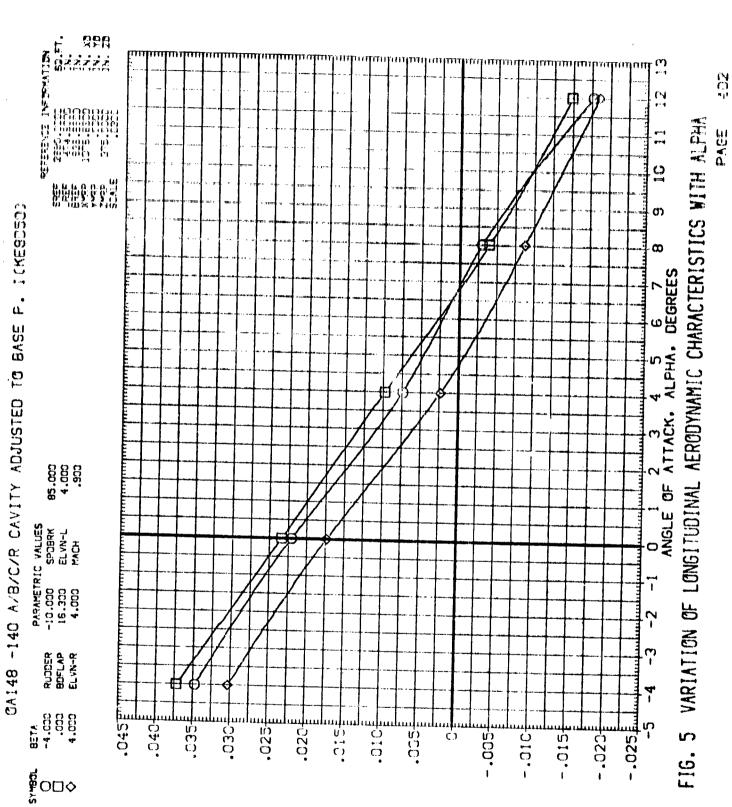


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ganga F REFERENCE INFORMATION <u>ات</u>ا. 269-650 474-650 673-650 1976-660 1976-660 1976-660 1976-660 1976-660 (T) CA148 -140 JBZCZR AVITY ADJUSTED TO BASE P. I(KE8D50) တ O 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES 85.000 4.000 .900 PAPAYETPIC . N.UES -10.000 SPOBRK 16.300 ELVN-L 4.000 MACH <del>٣</del> RUDDER BOFLAP ELVN-R .1275星 1210 .1270皇 1265長 .1260皇 .1245長 .1255春 -1250春 .1240長 1230年 1235年 .1225年 .1215年 -1220長 § O□¢

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



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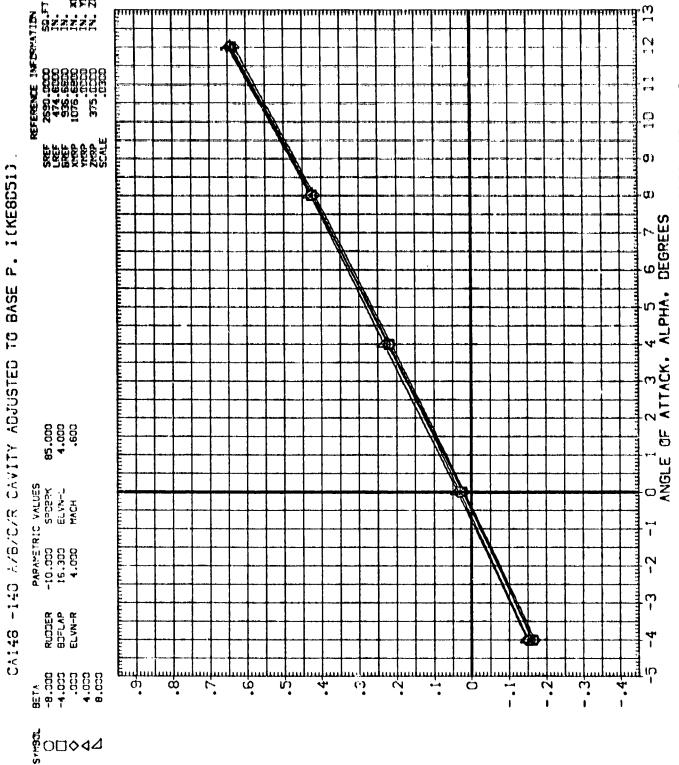
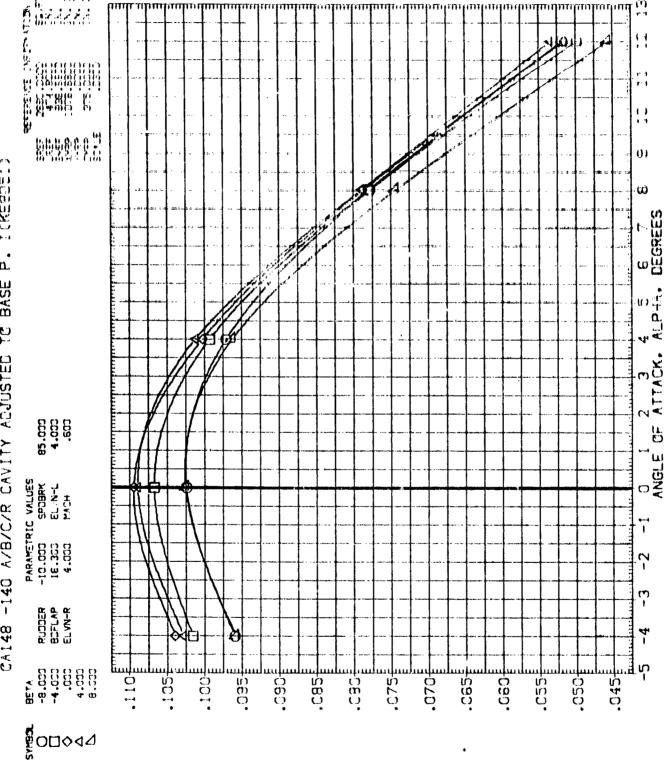


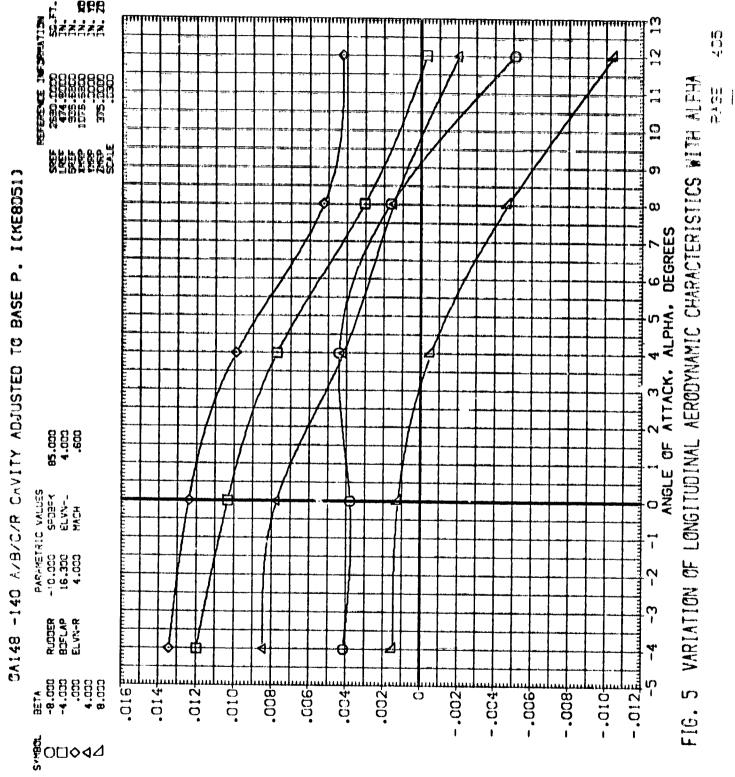
FIG. S VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

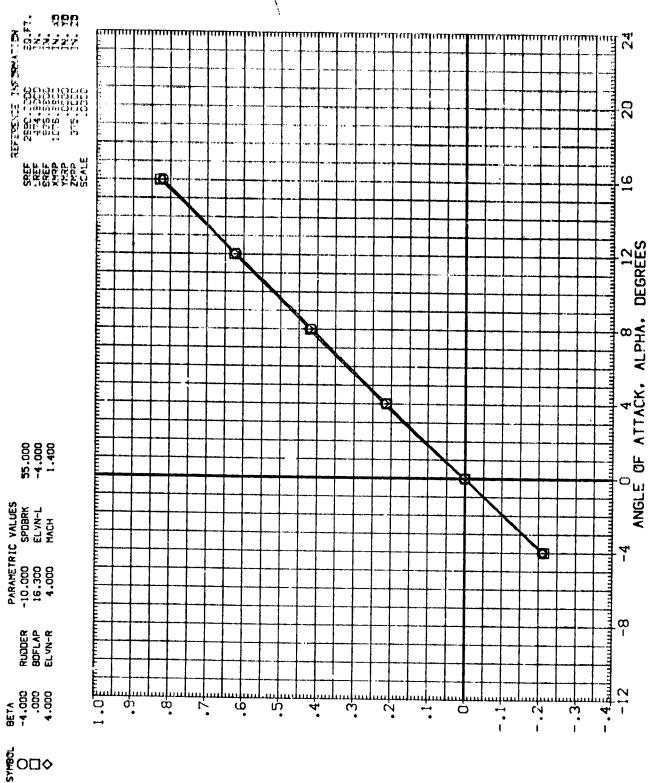


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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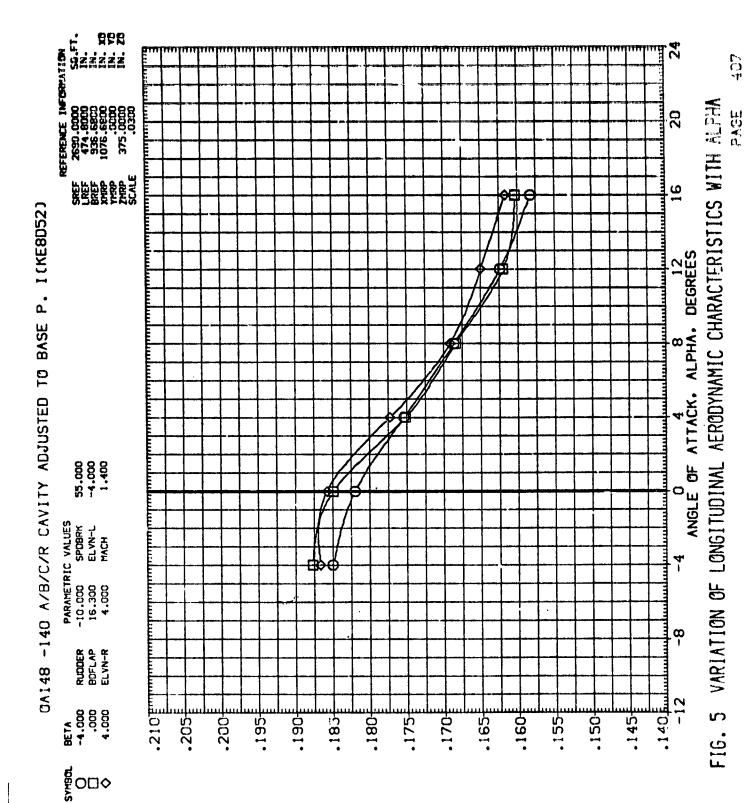


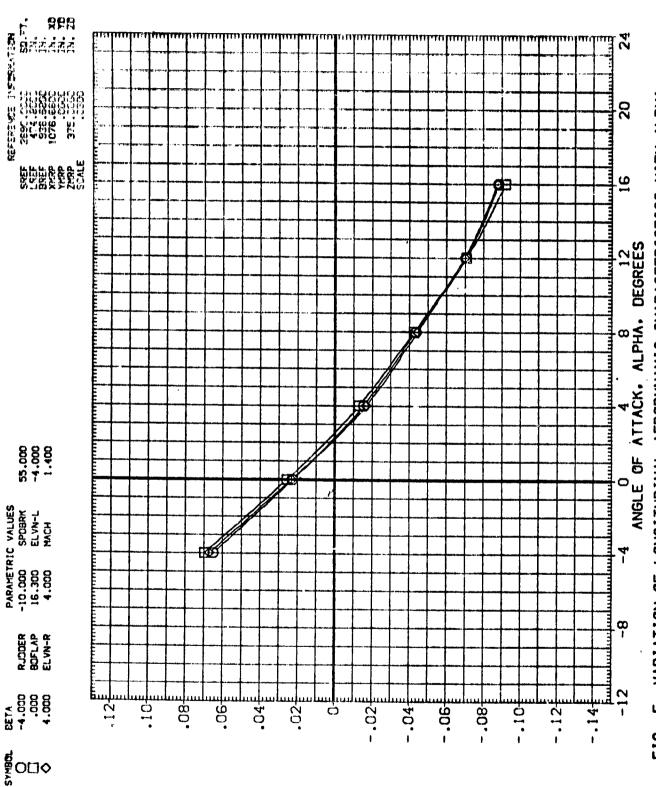


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FIG. 5 VARIATION OF LONGITUDINAL AEPODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

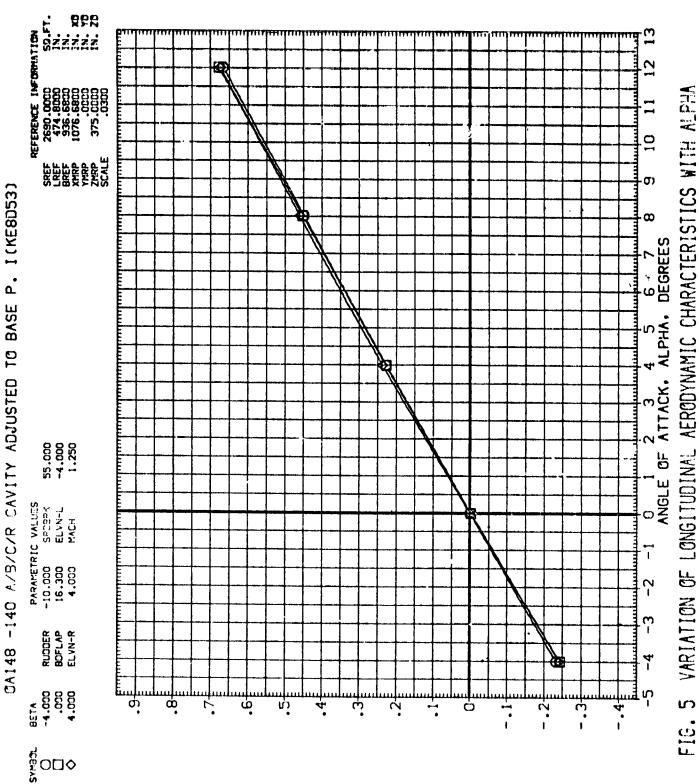
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



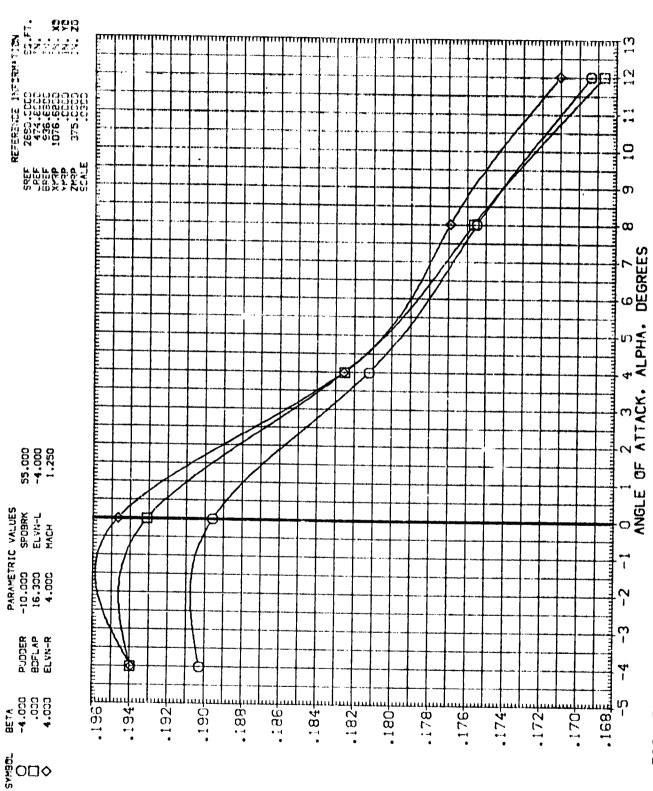
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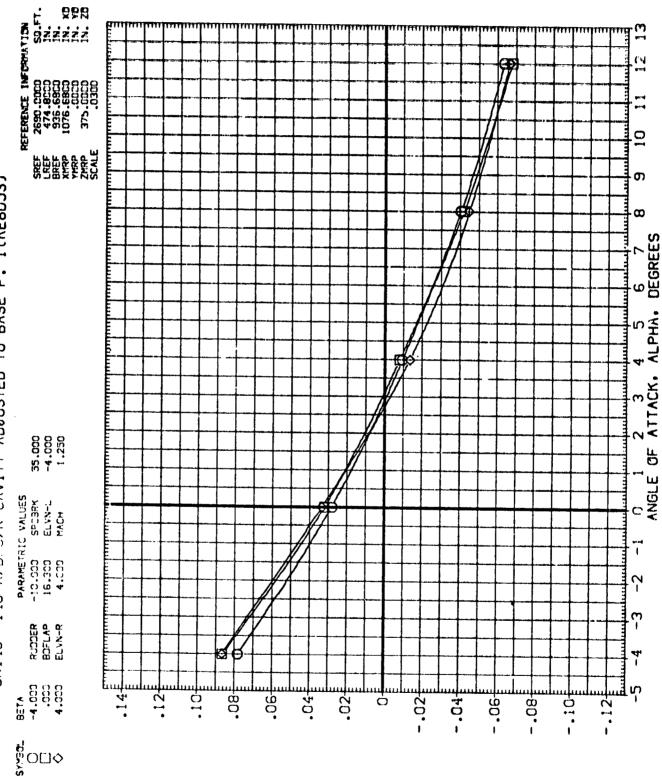
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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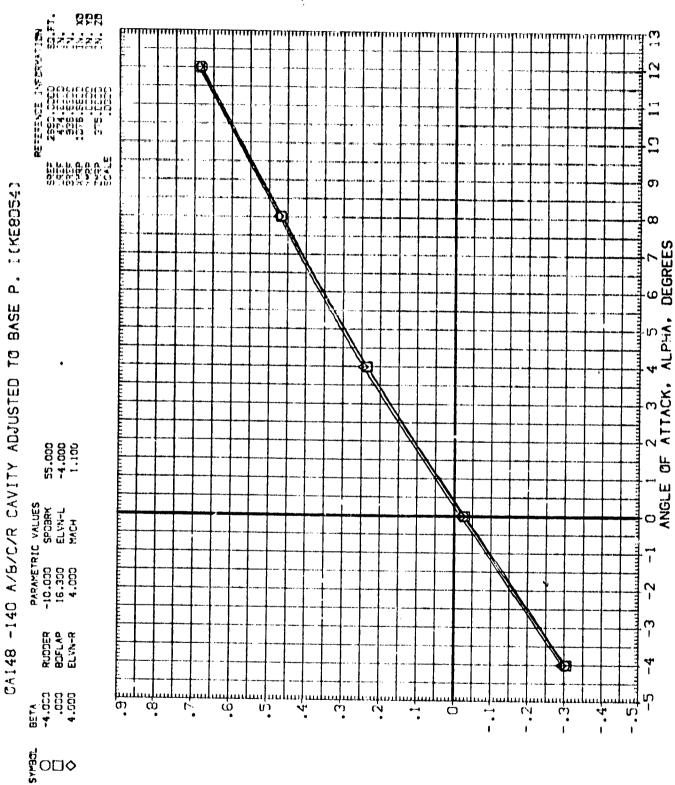
CA148 -140 A/3/C/R CAVITY ADJUSTED TO BASE P. ICKE8D53)



VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

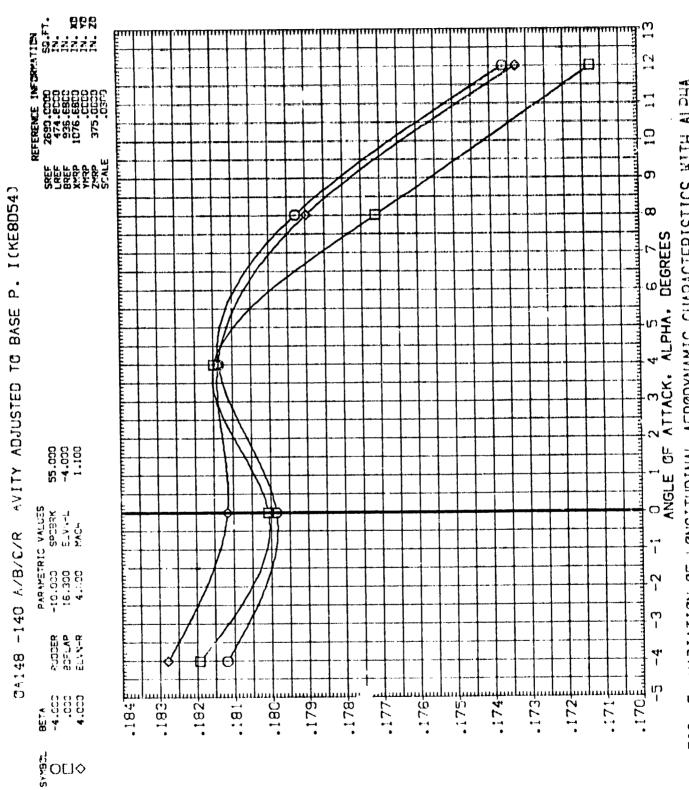
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA VAPIATION OF <u>.</u>

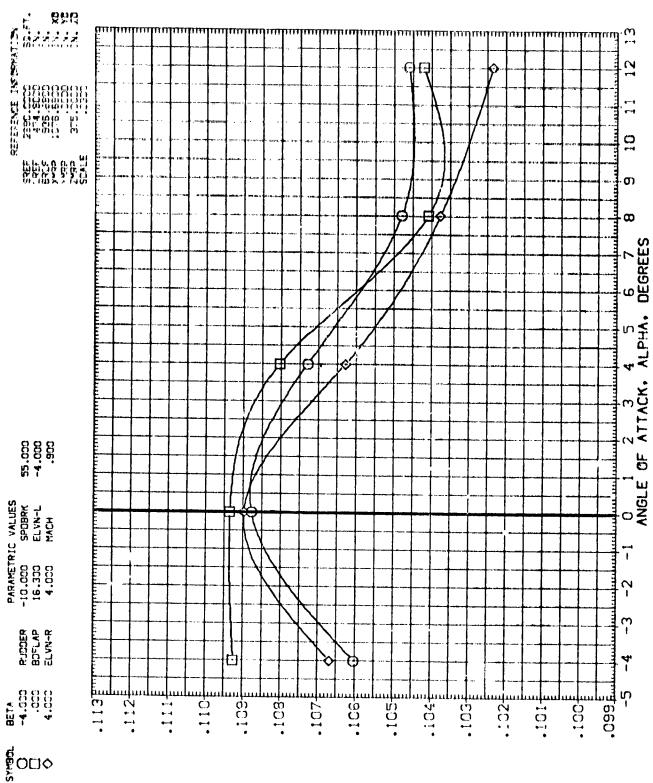
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA O GA148 -140 A/B/C/R CAVITY ADJUSTED IG BASE P. 11KE8D55) O)  $\boldsymbol{\varpi}$ ANGLE OF ATTACK. ALPHA. DEGREES 55.000 -4.000 PARAMETRIC VALLES
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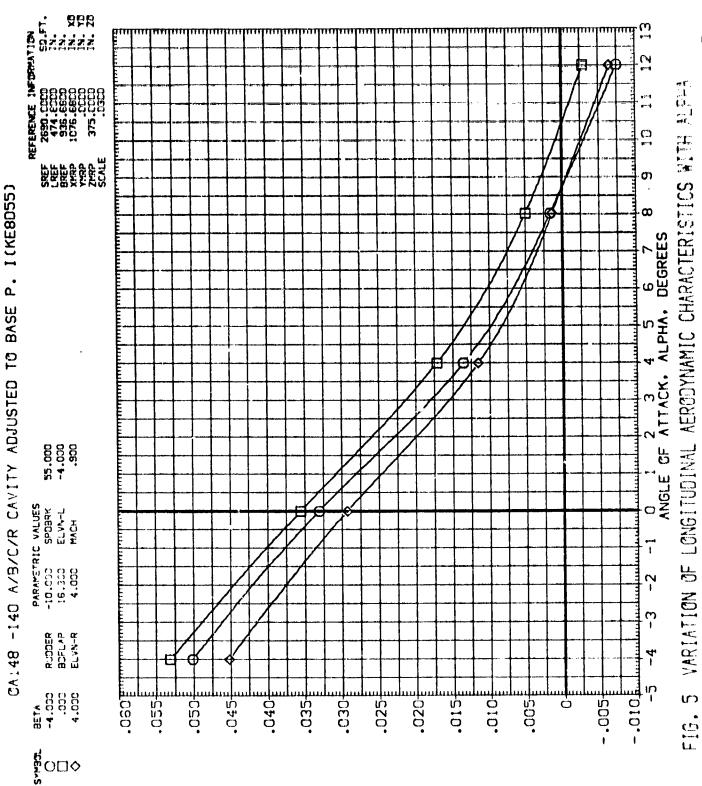


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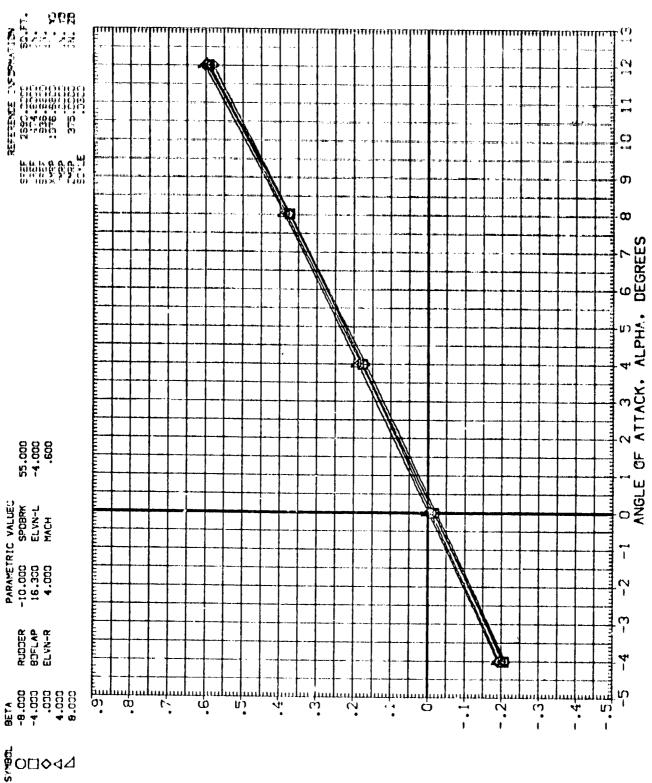
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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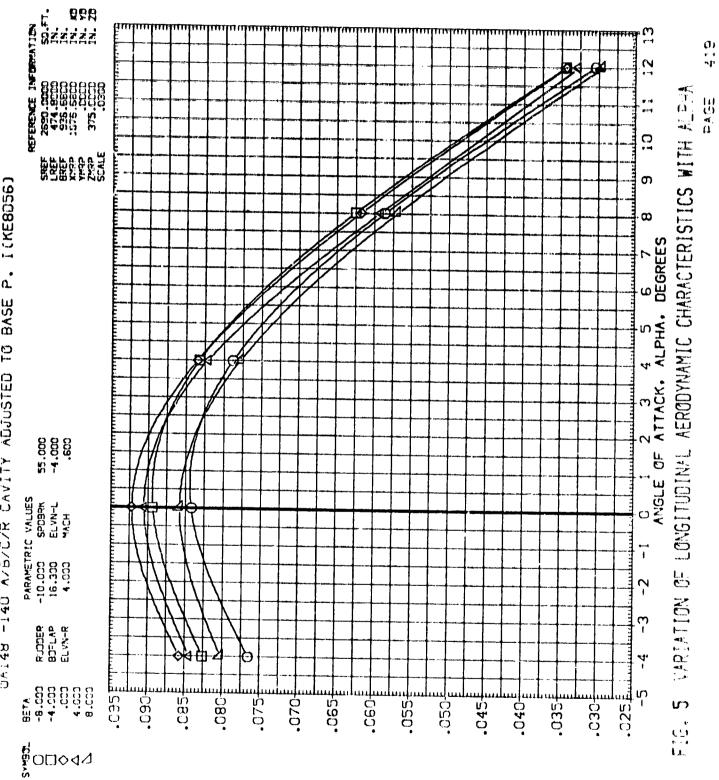


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VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA FIG. 5

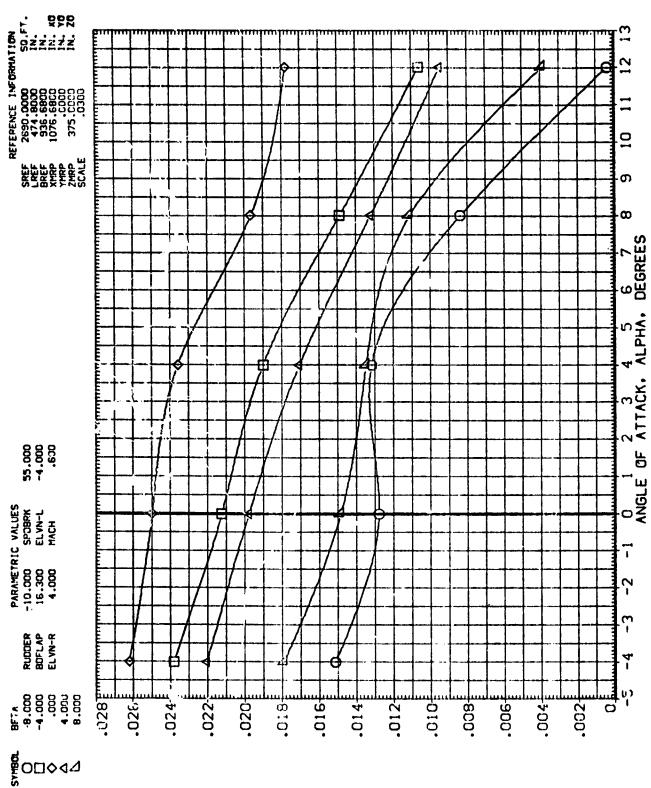
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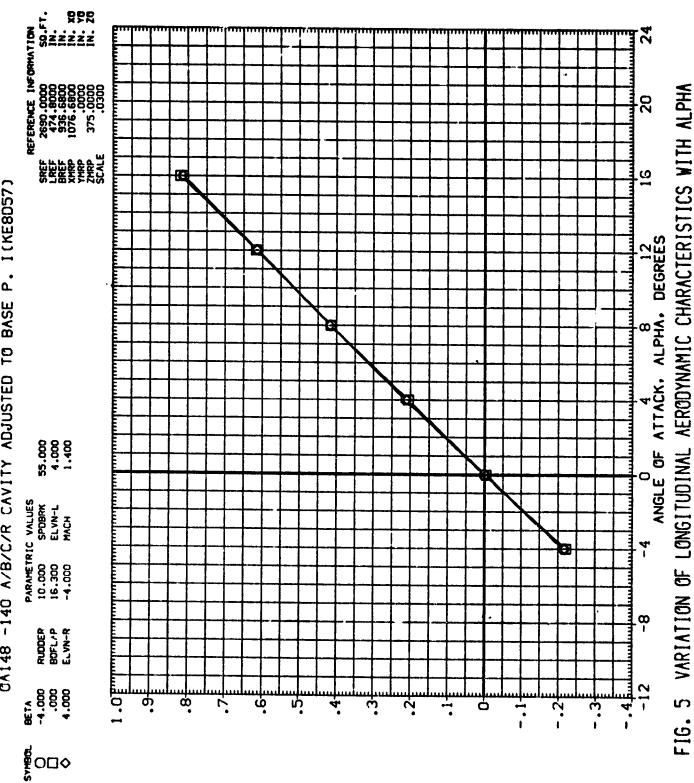
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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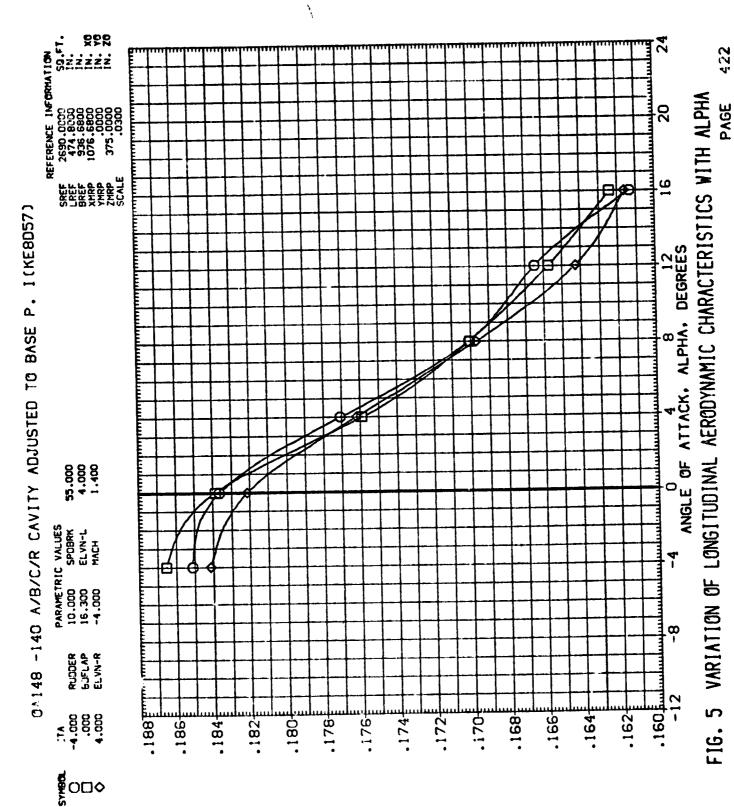
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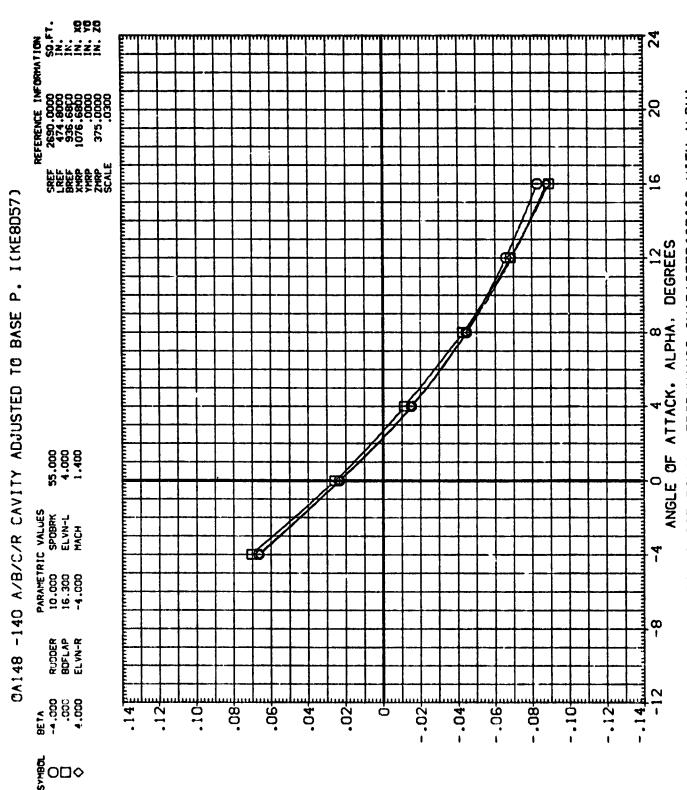
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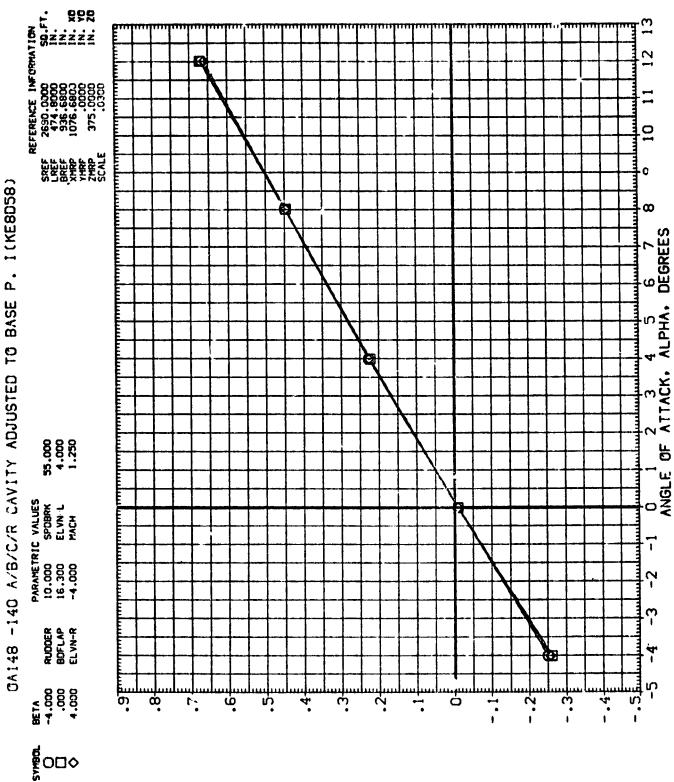
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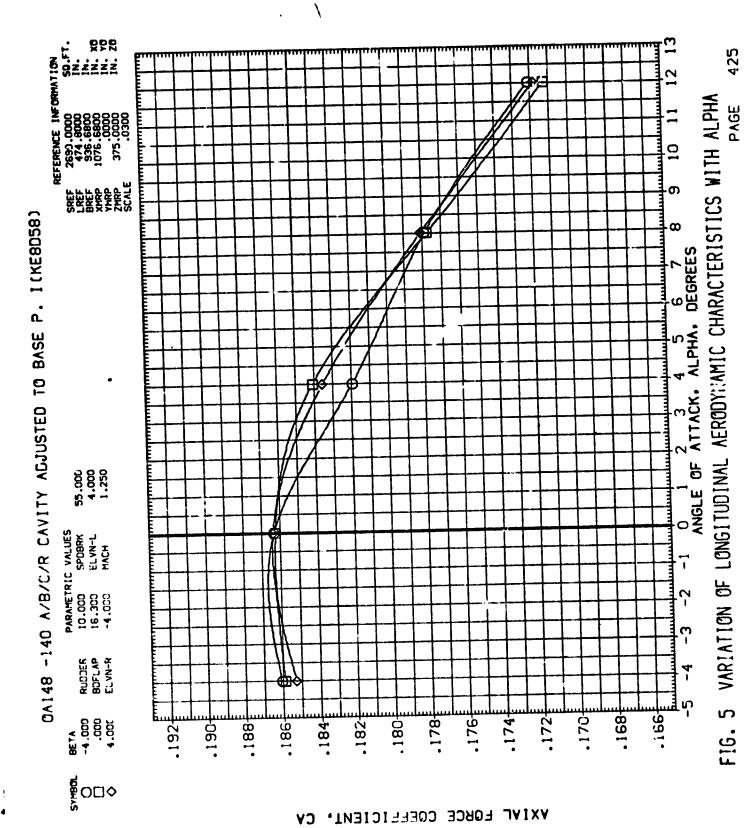
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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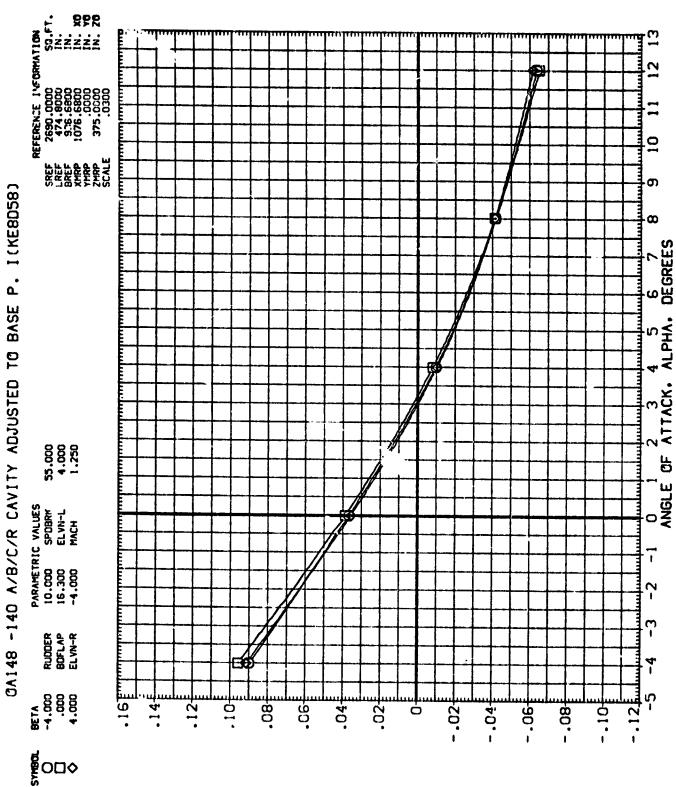
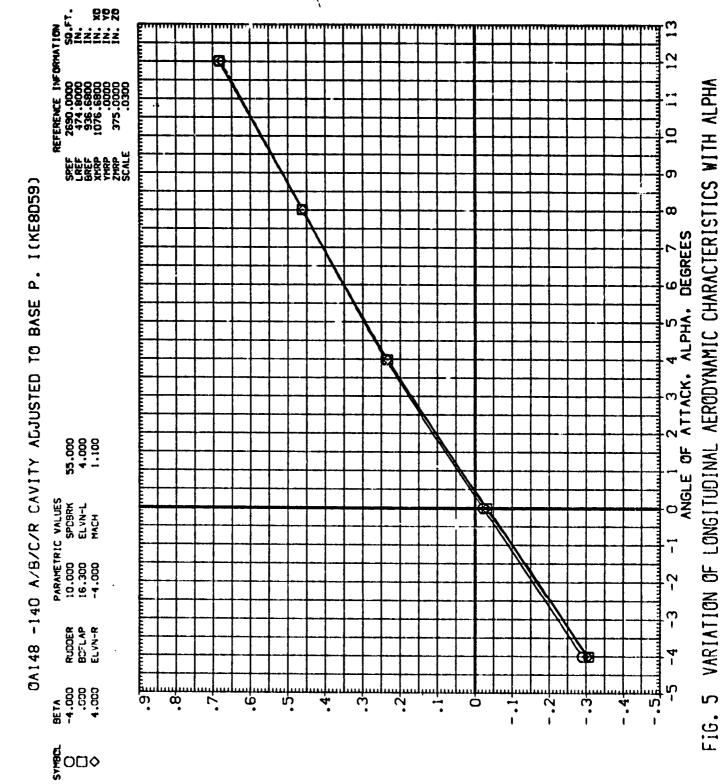


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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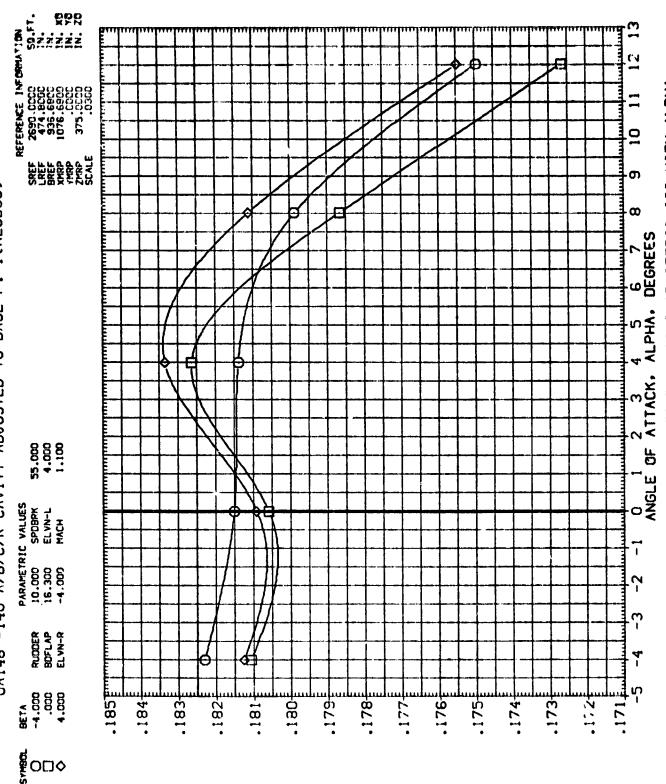
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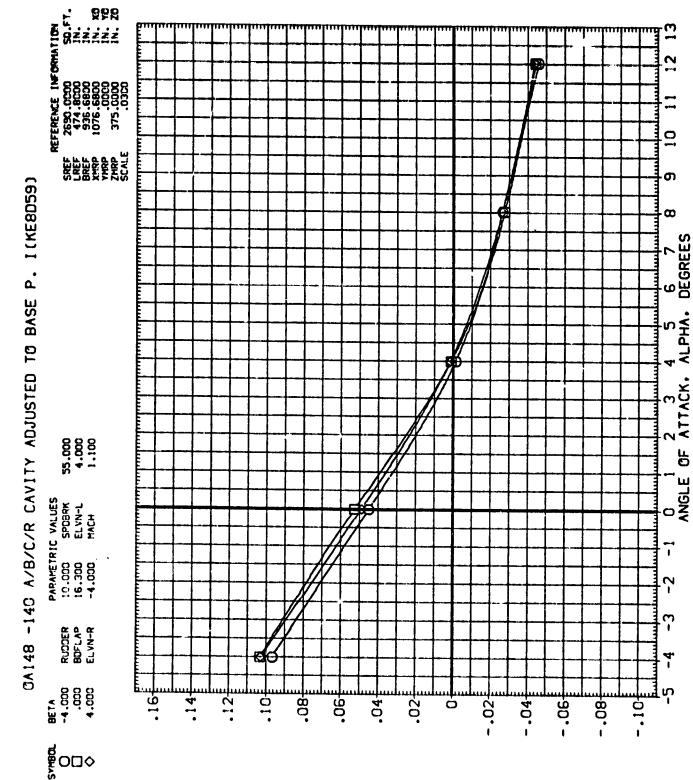
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISLICS WITH ALPHA

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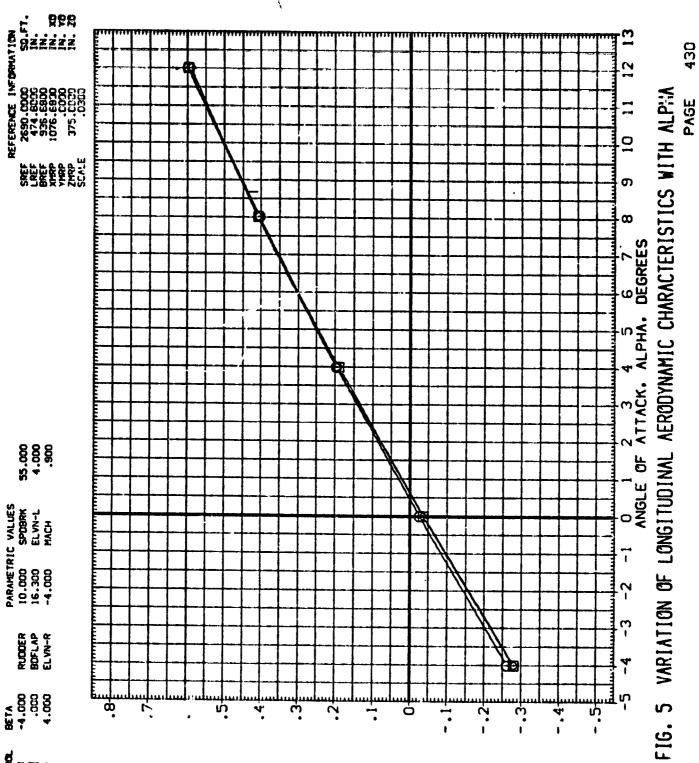


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

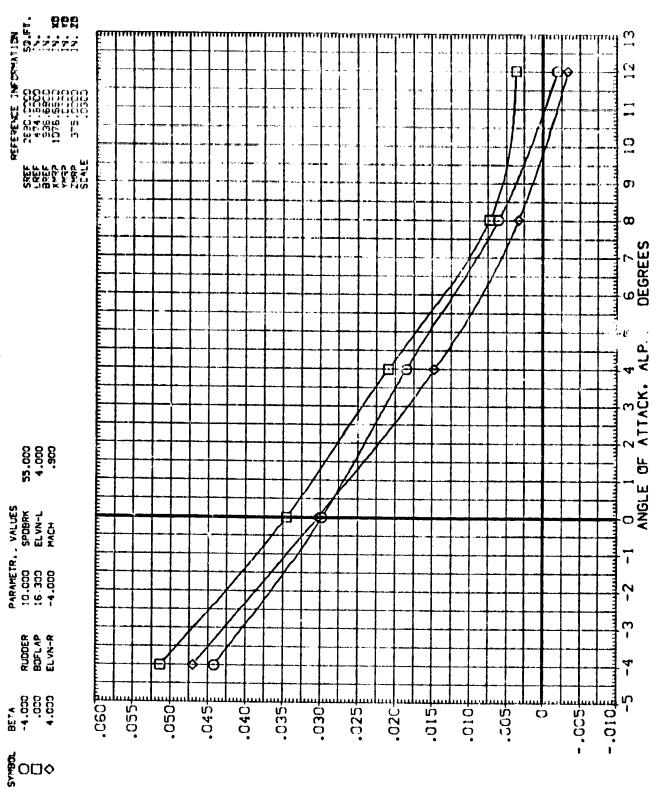


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC UNARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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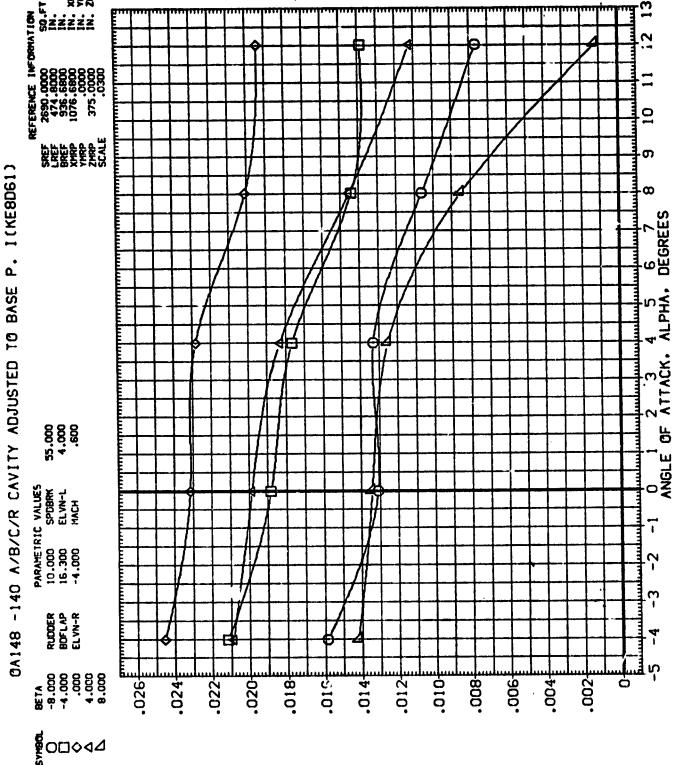
434 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE O 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES F16.5

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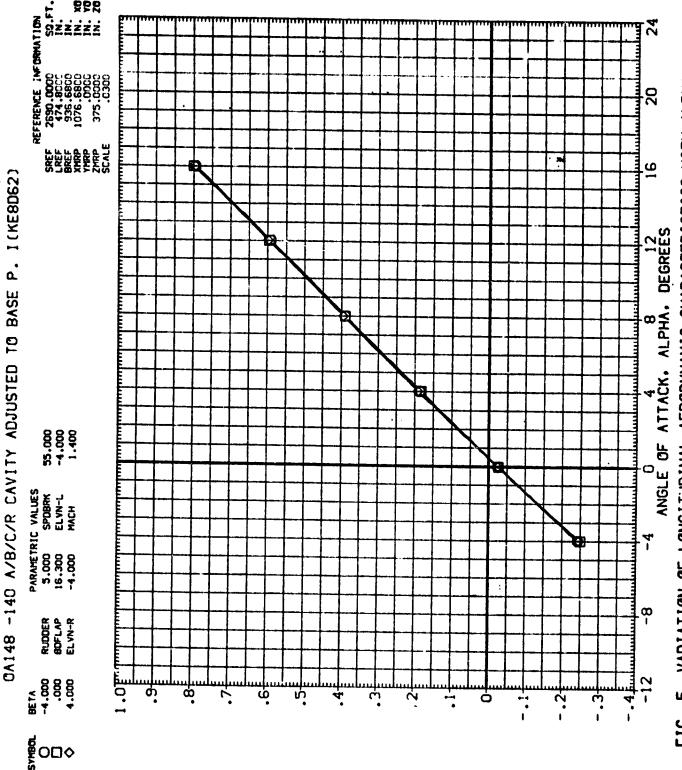
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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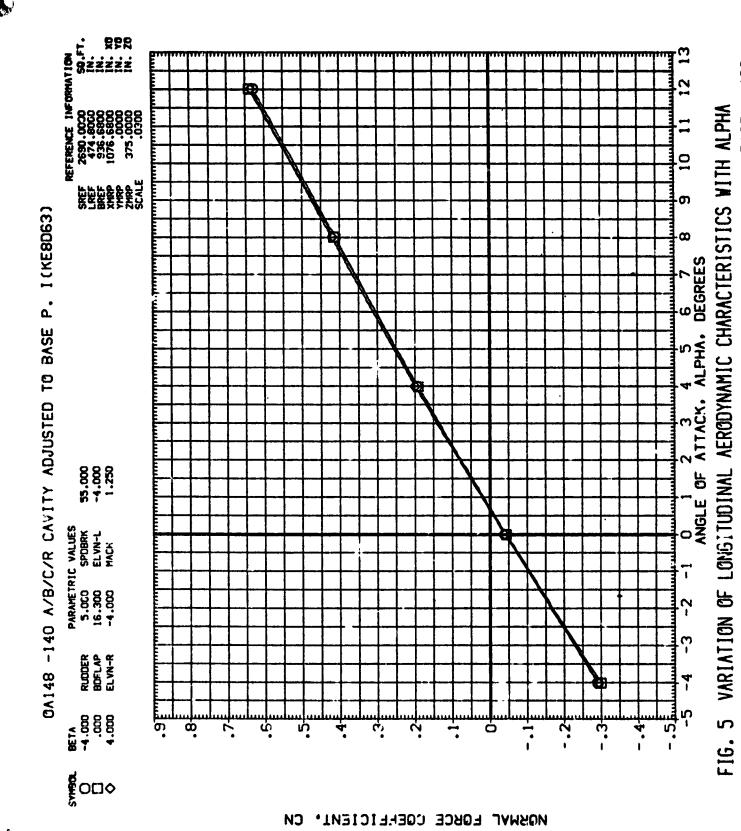
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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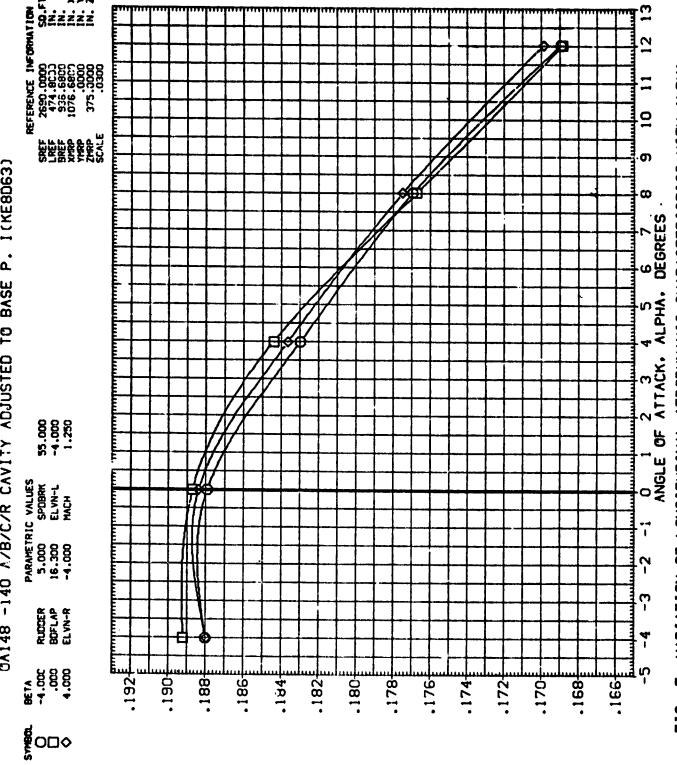
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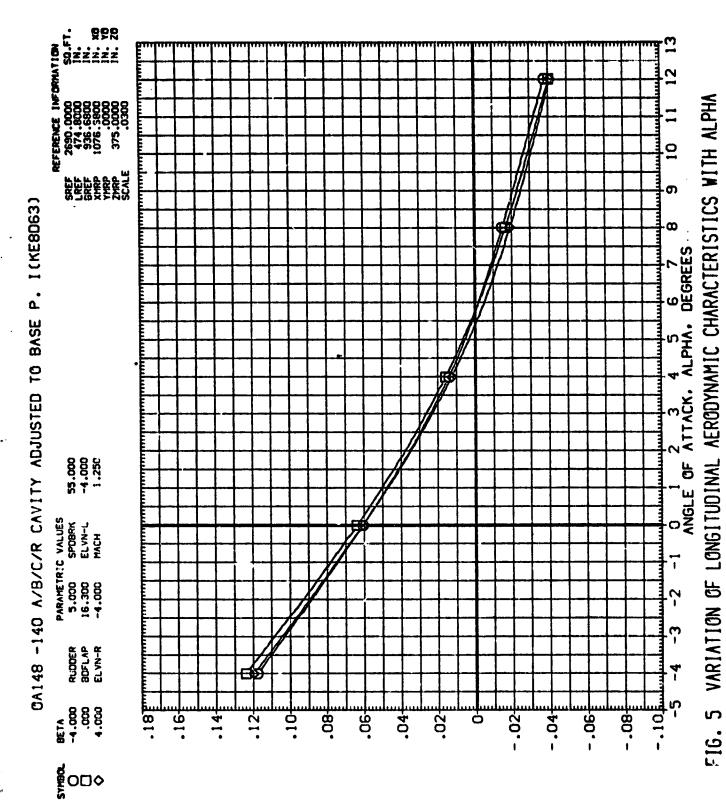
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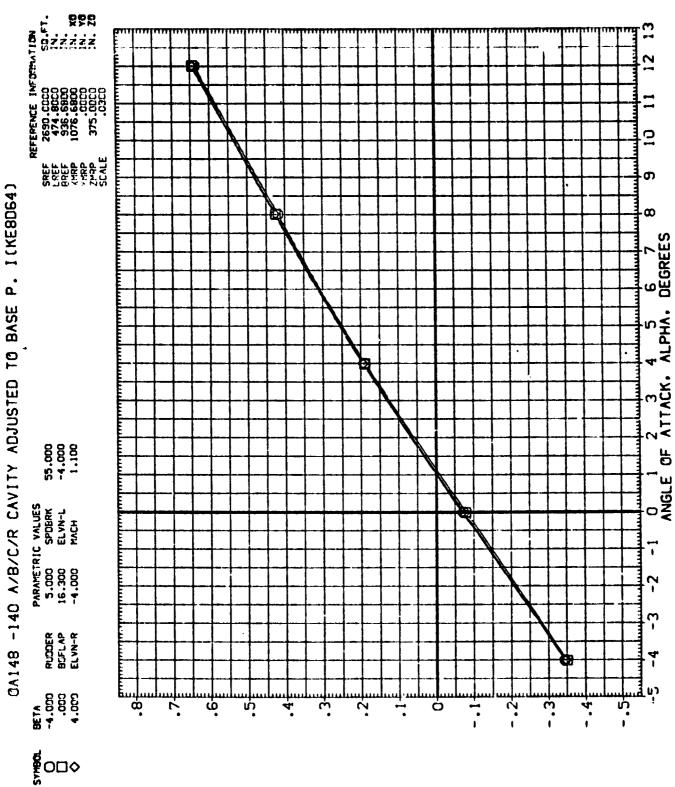
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

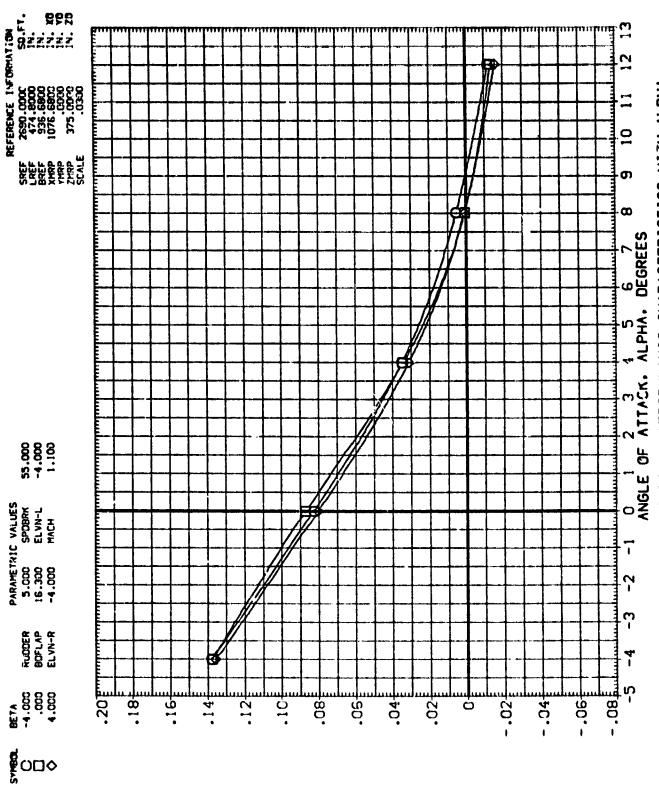
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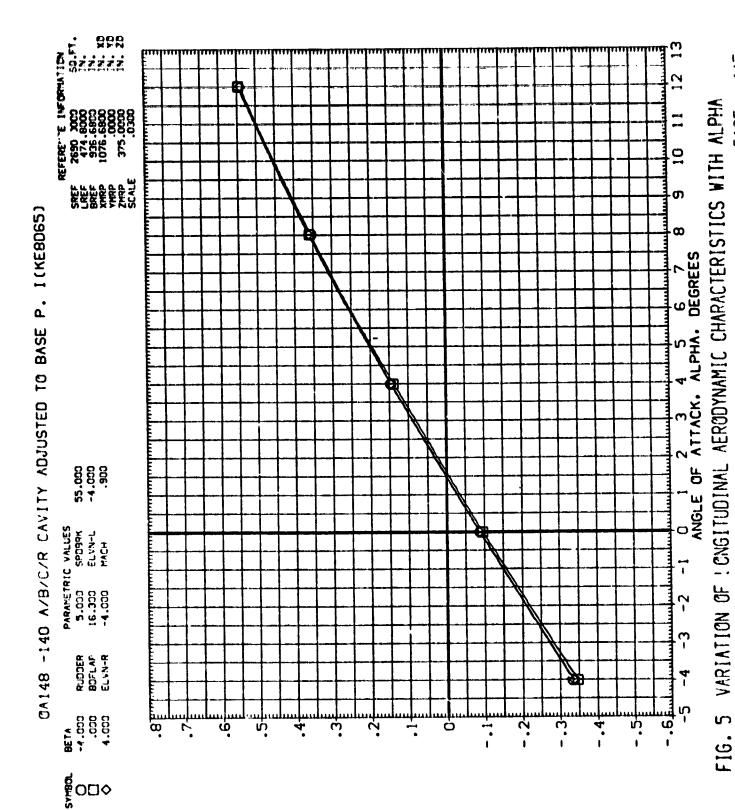
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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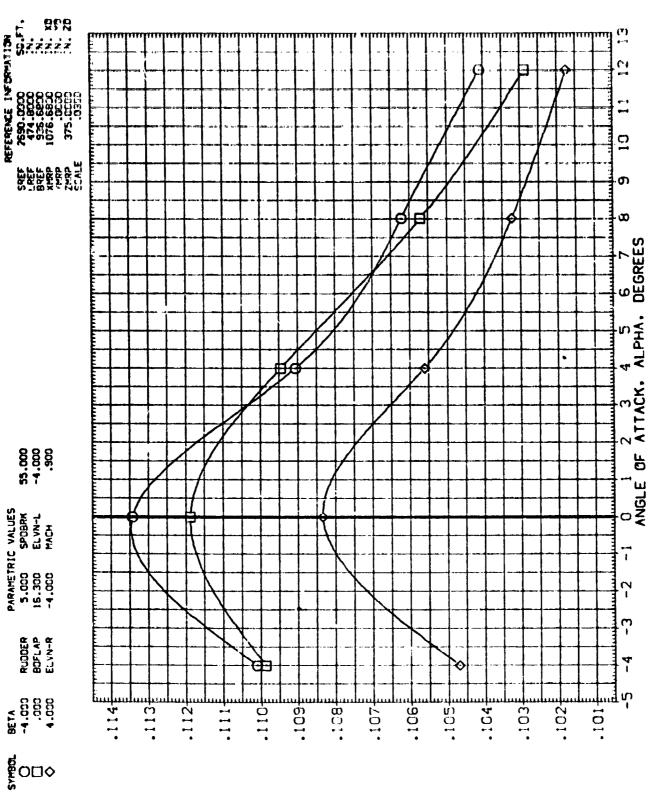


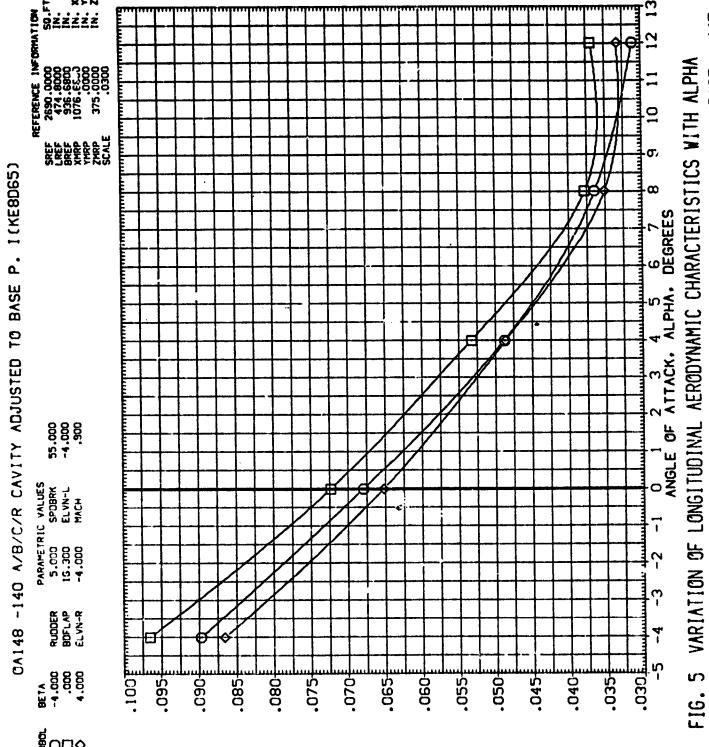
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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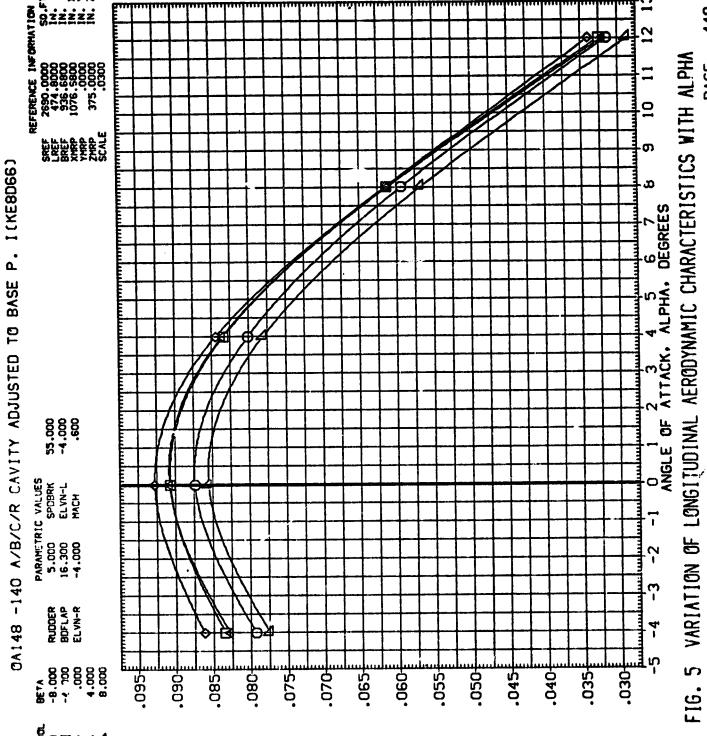
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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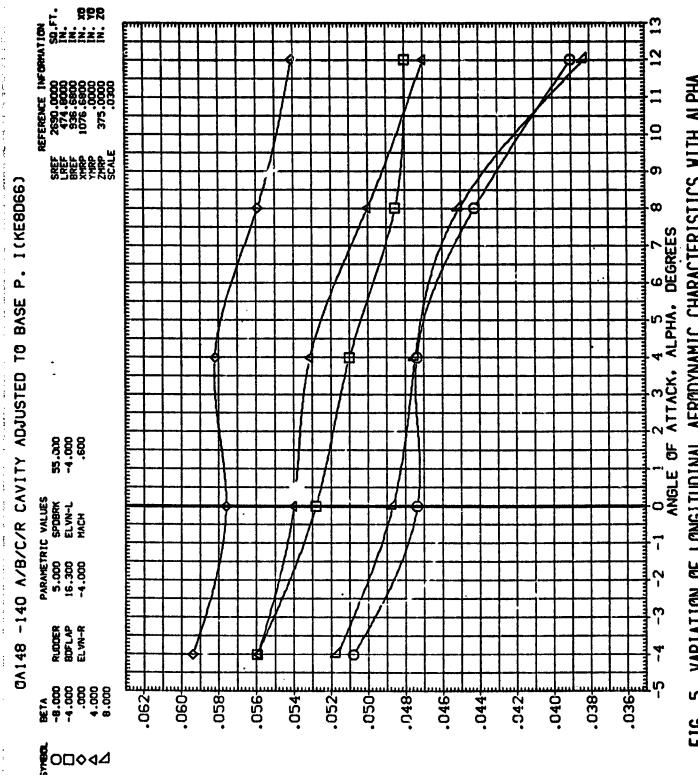
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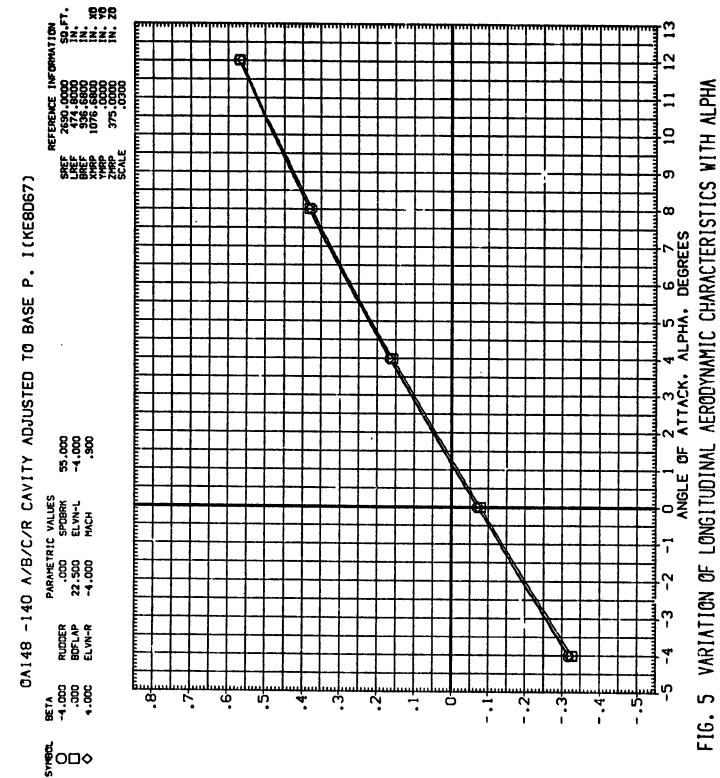
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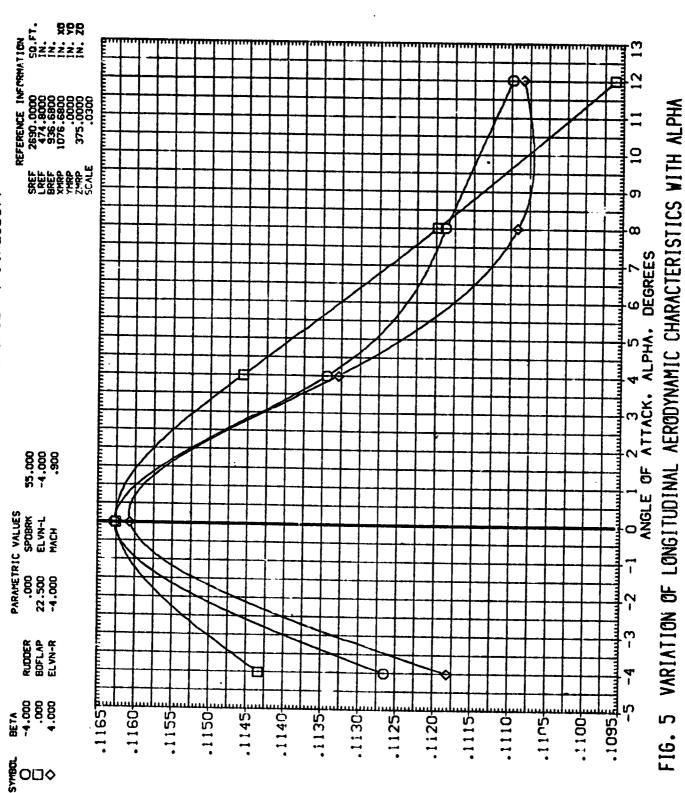
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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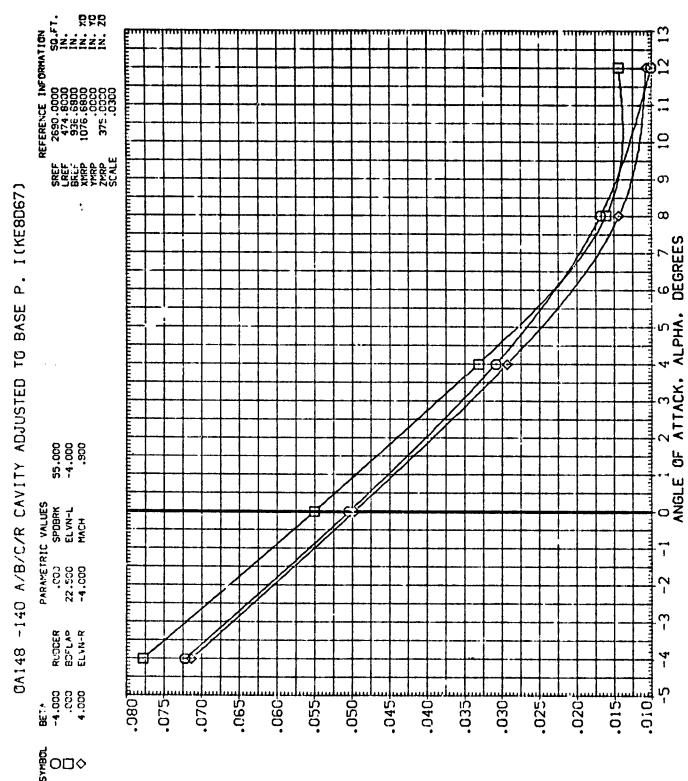
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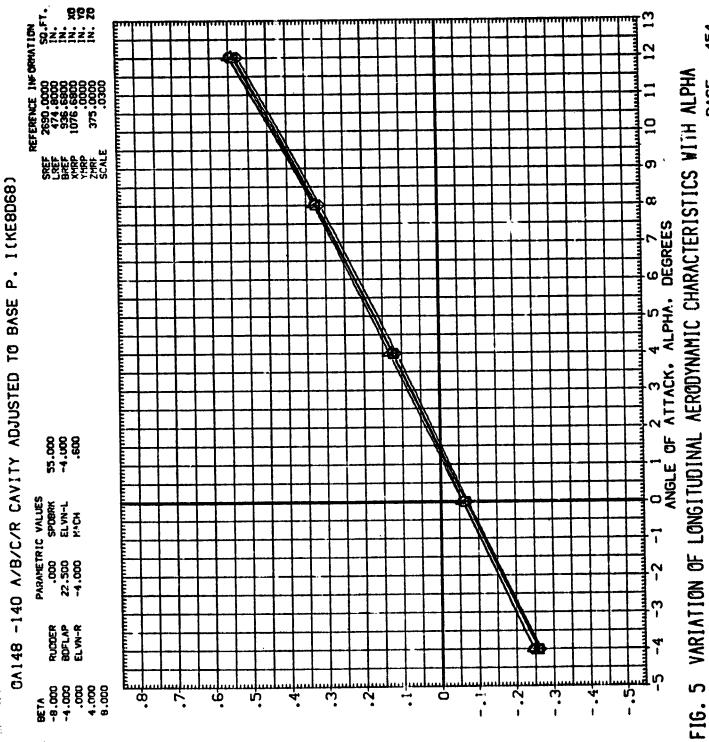
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

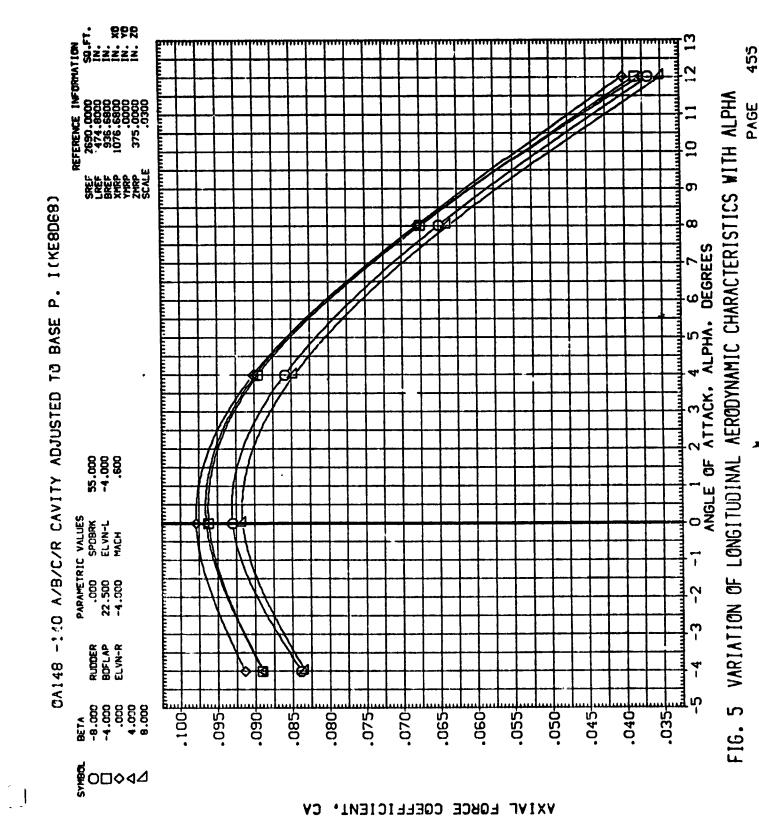


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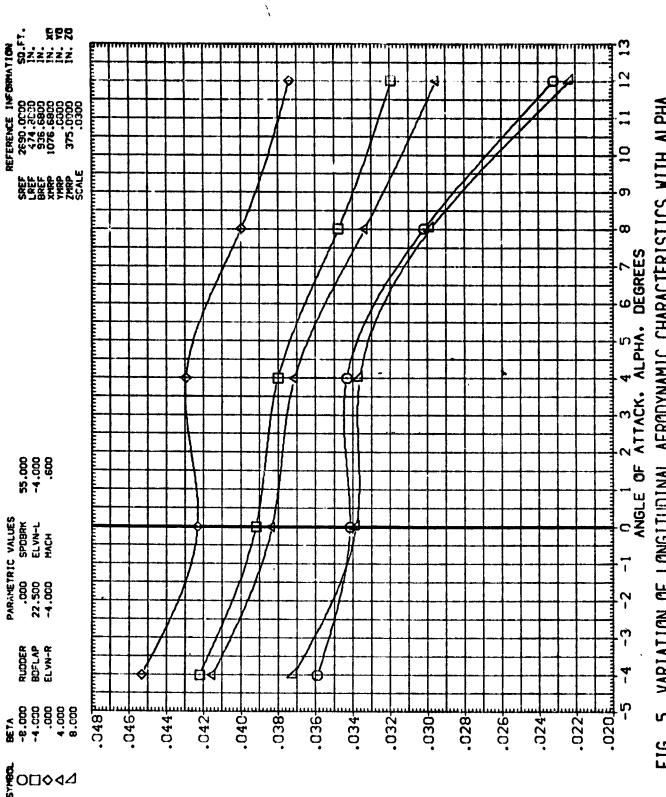
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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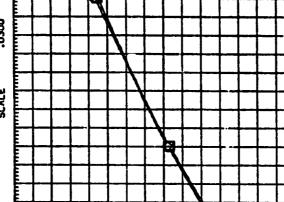
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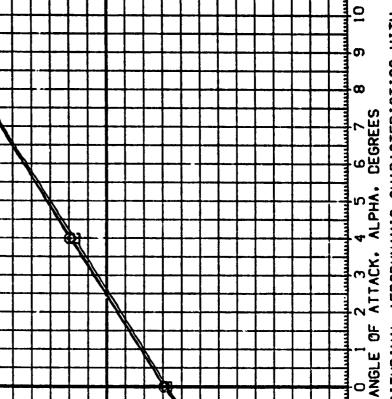
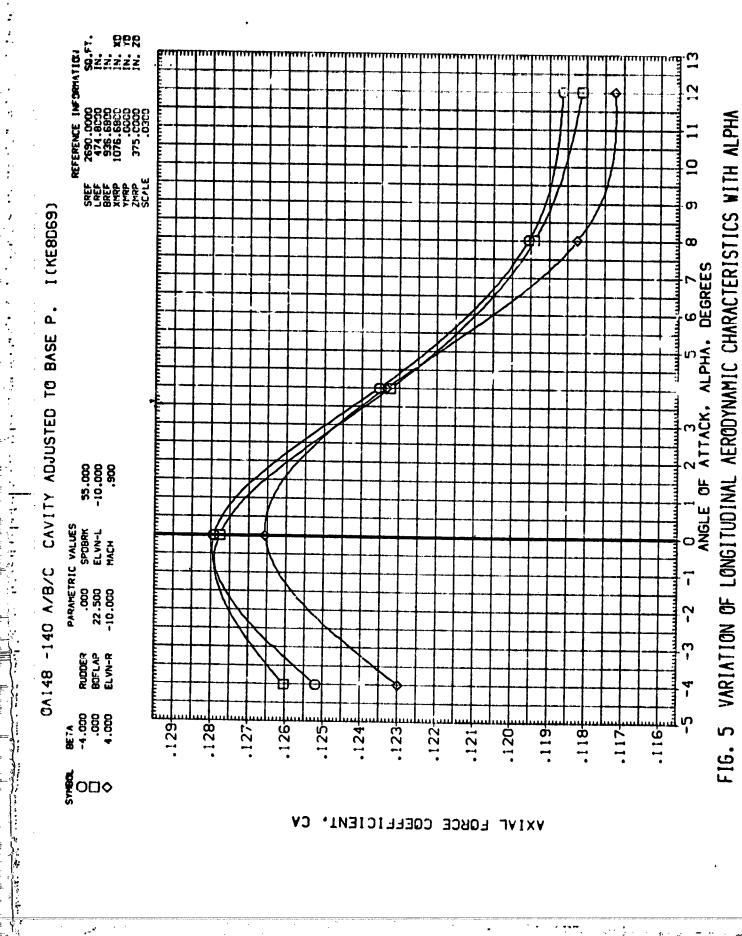


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

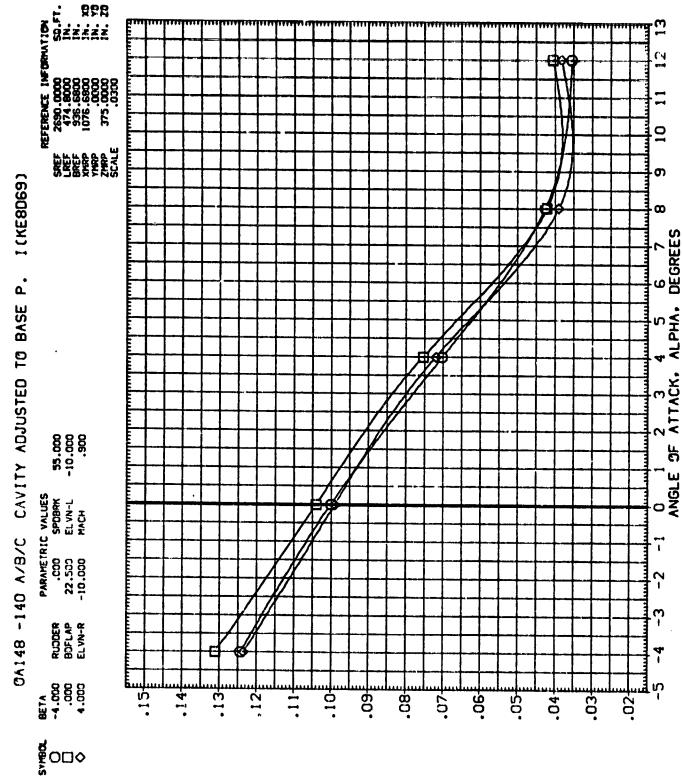
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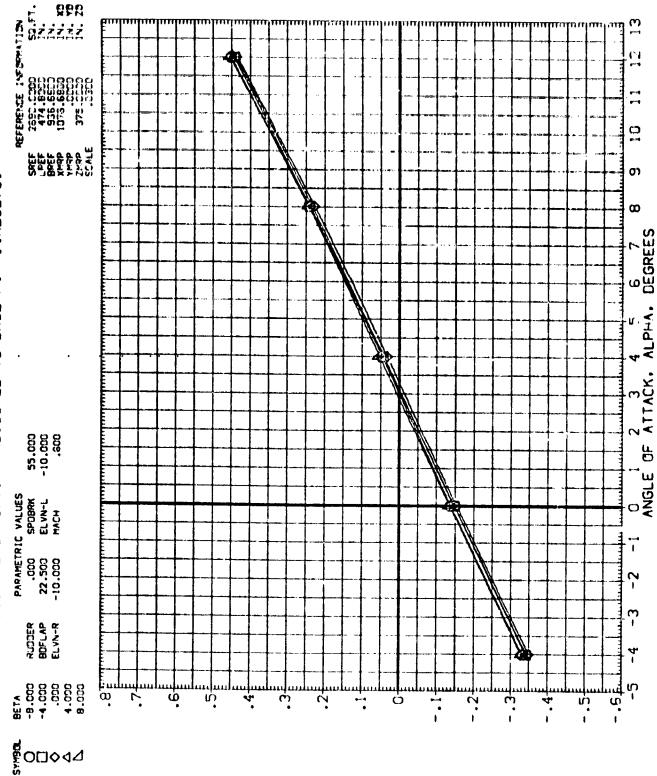
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA 39¥a

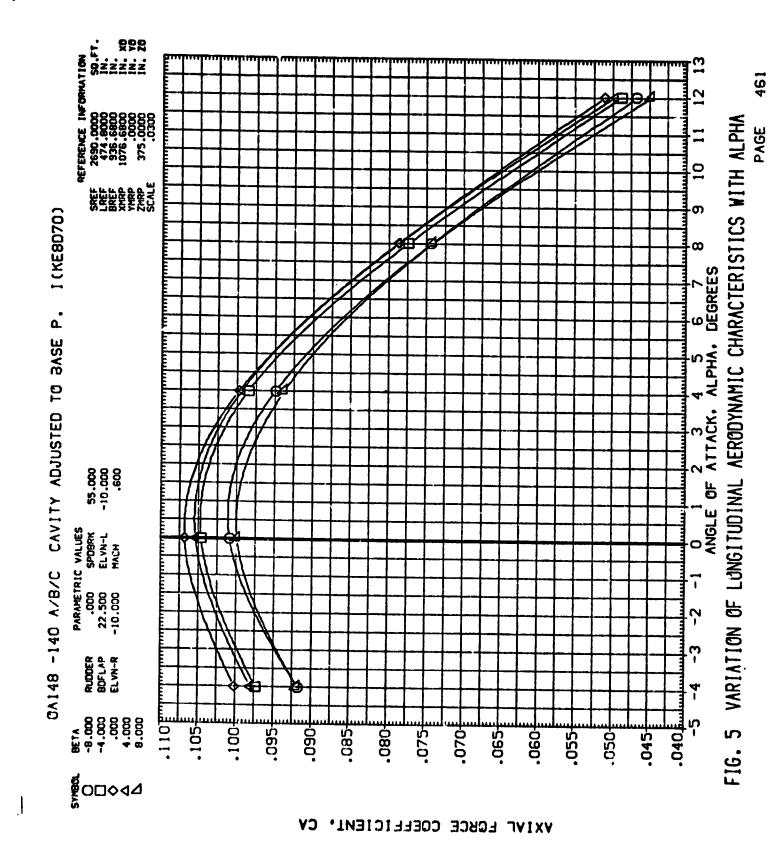
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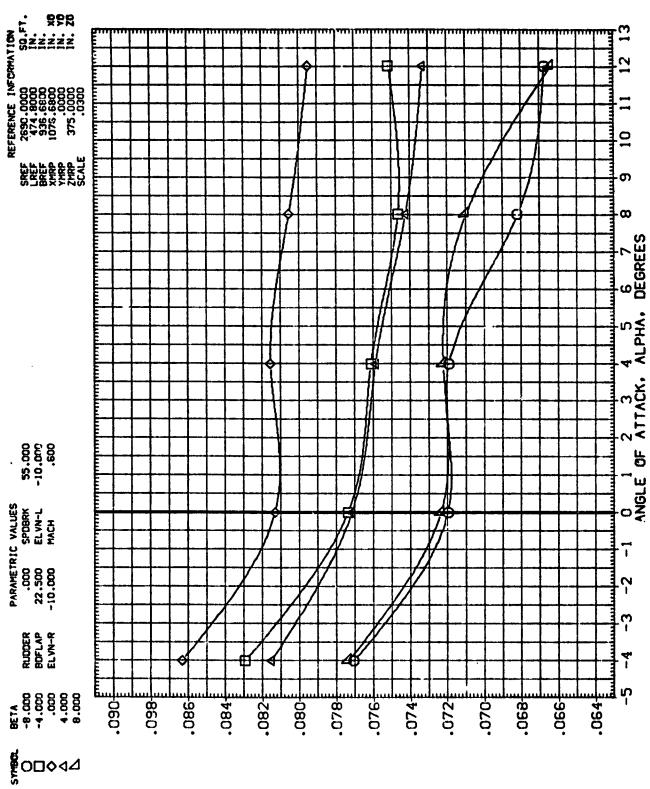


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FIG. S VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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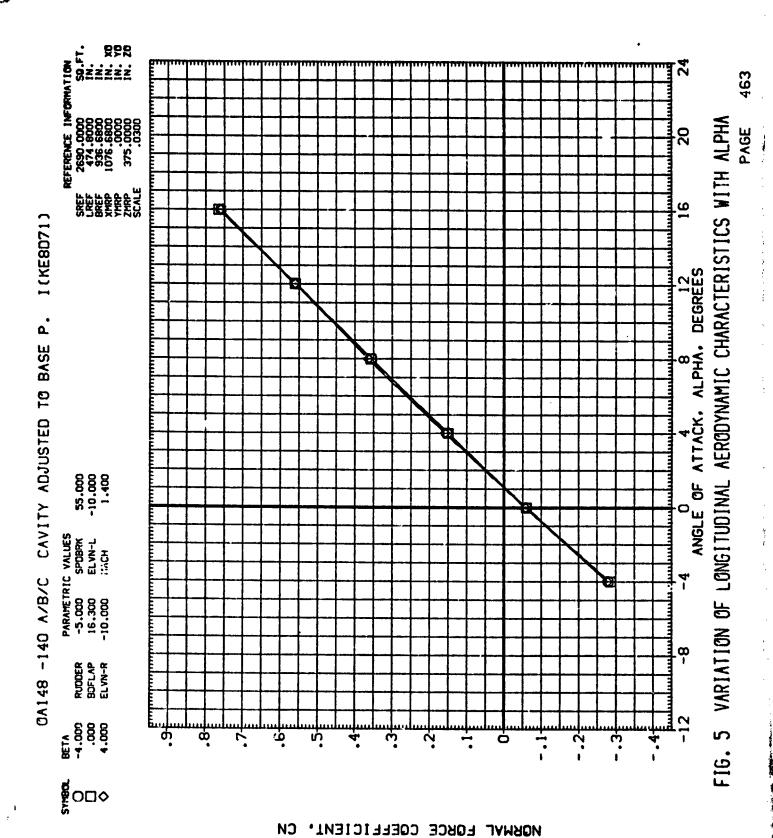




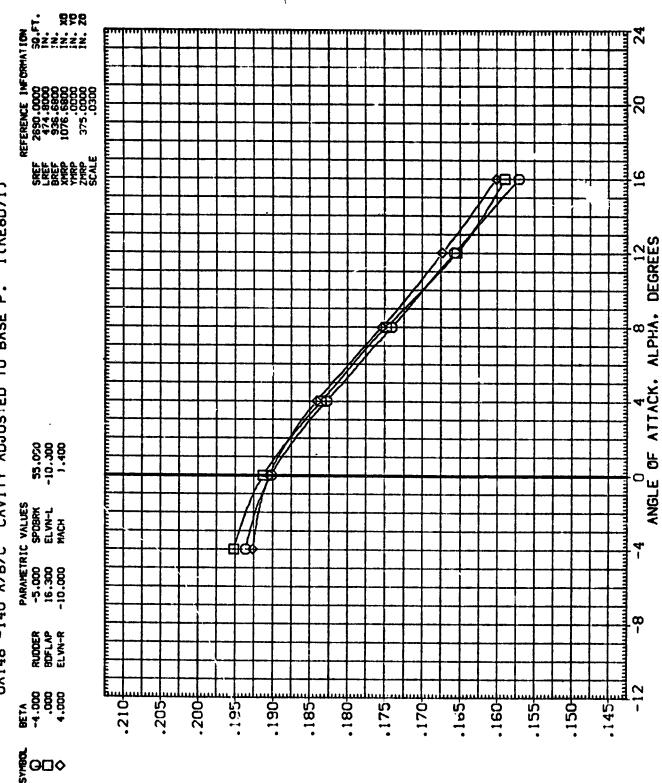
PITCHING MOMENT COEFFICIENT, CLM

FIG. 5 VARIATION OF LONGITUDINAL AFRODYNAMIC CHARACTERISTICS WITH ALPHA

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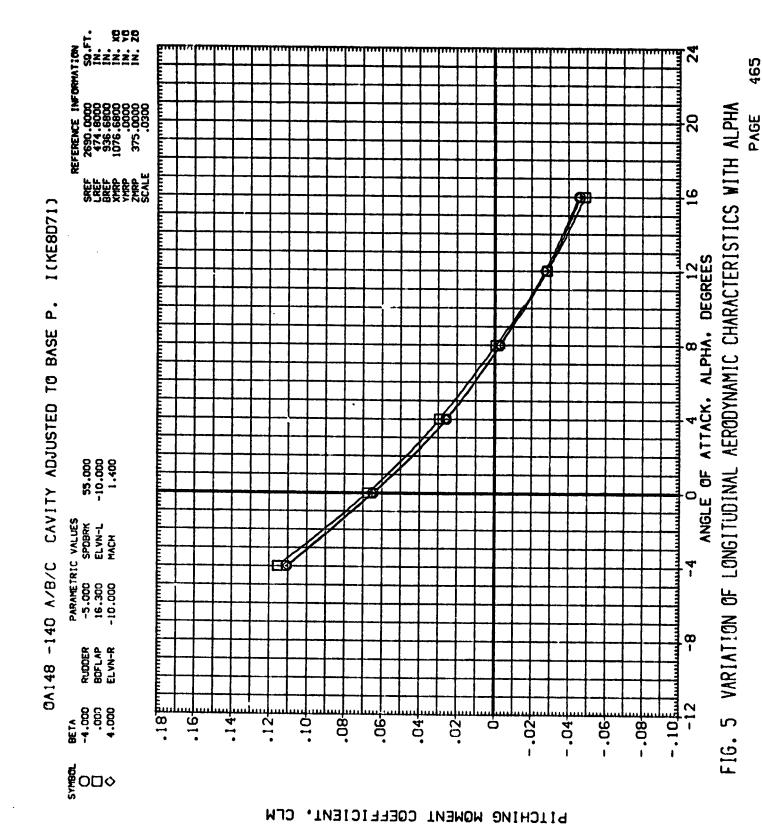


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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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1 (KE8D72) CA148 -140 A/B/C CAVITY ADJUSTED TO BASE P.

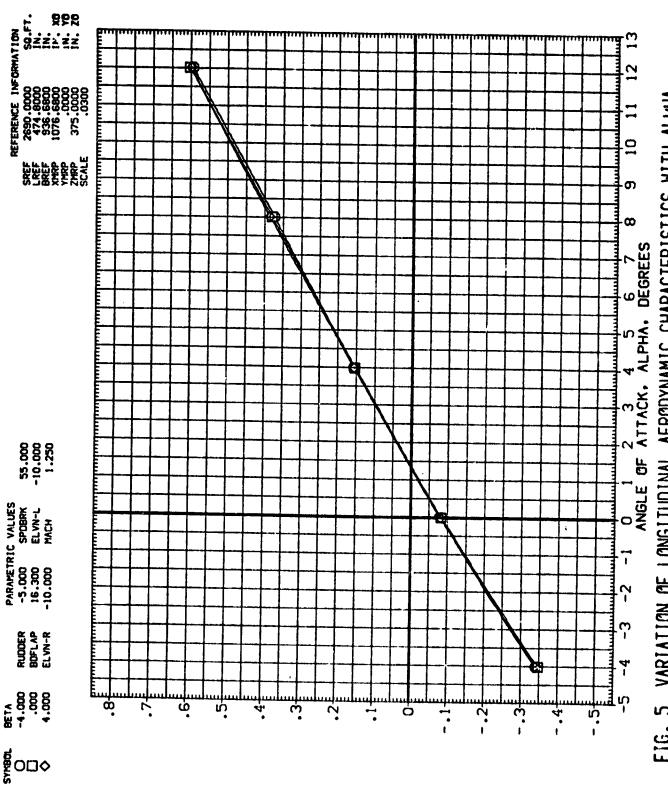
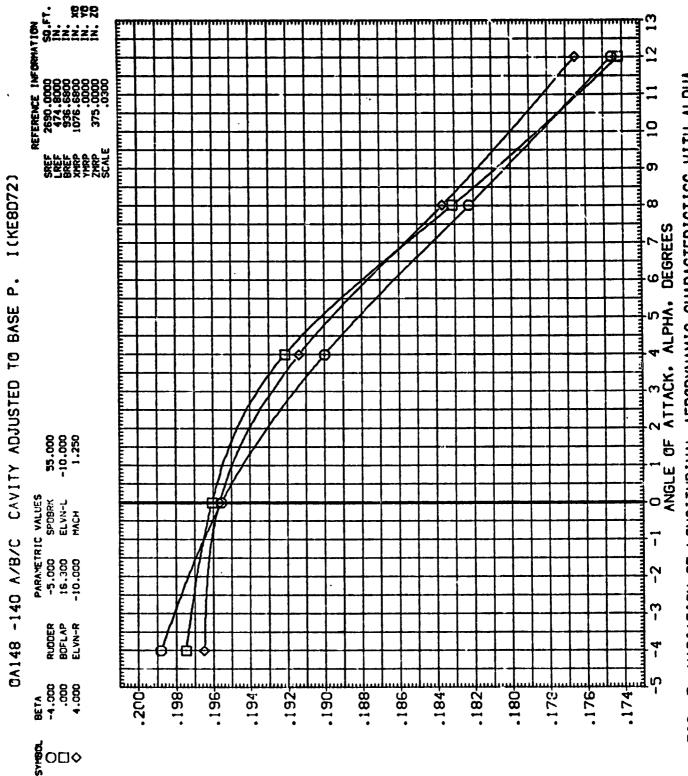


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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NORMAL FORCE COEFFICIENT, CN

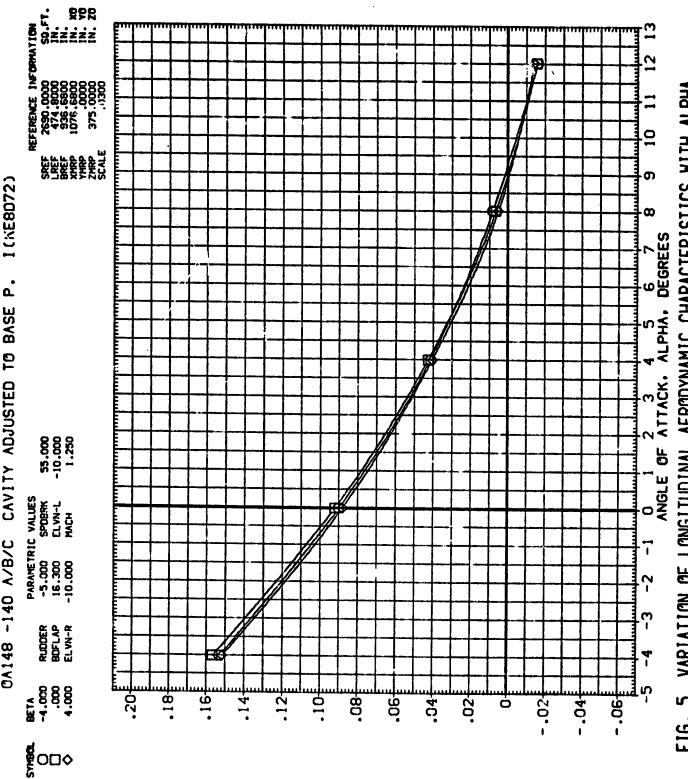


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467 FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

0A148 -140 A/B/C CAVITY ADJUSTED TO BASE P.

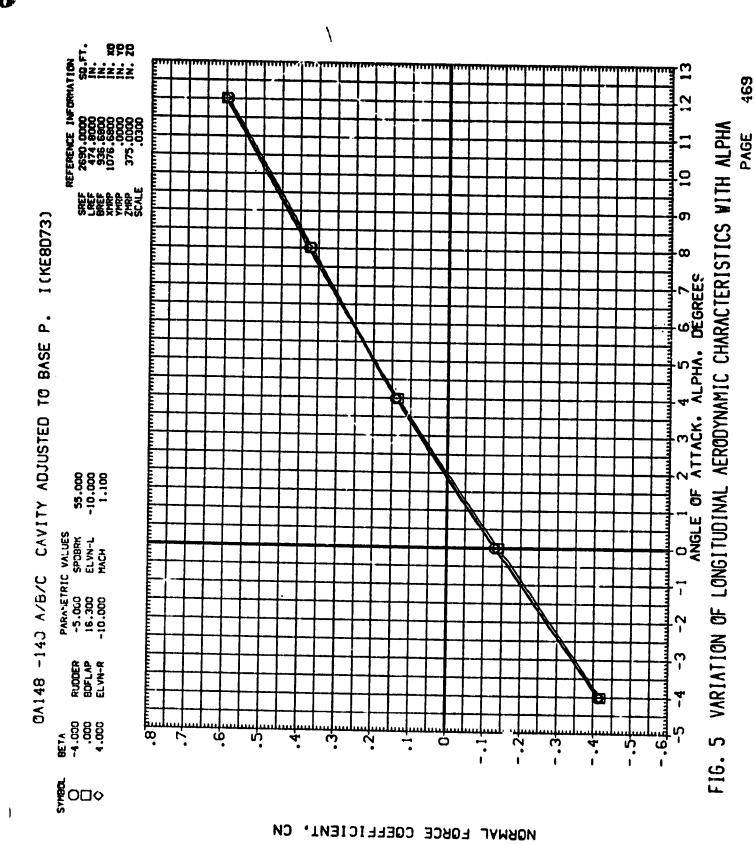
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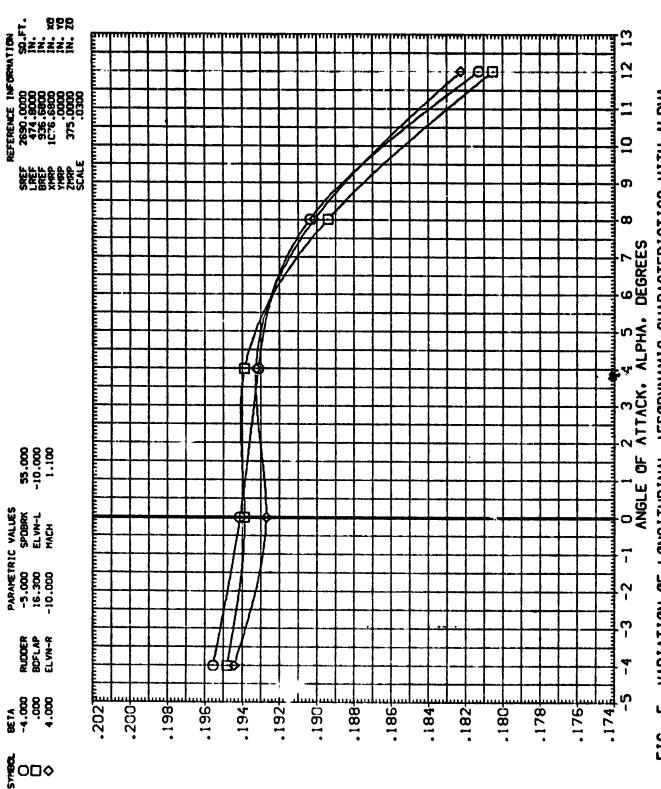


PITCHING MOMENT COEFFICIENT, CLM

FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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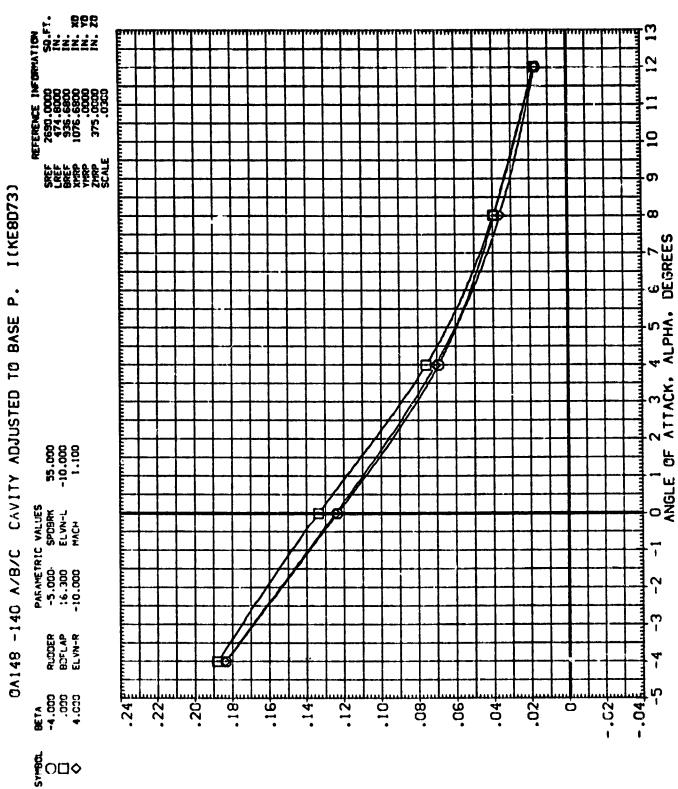




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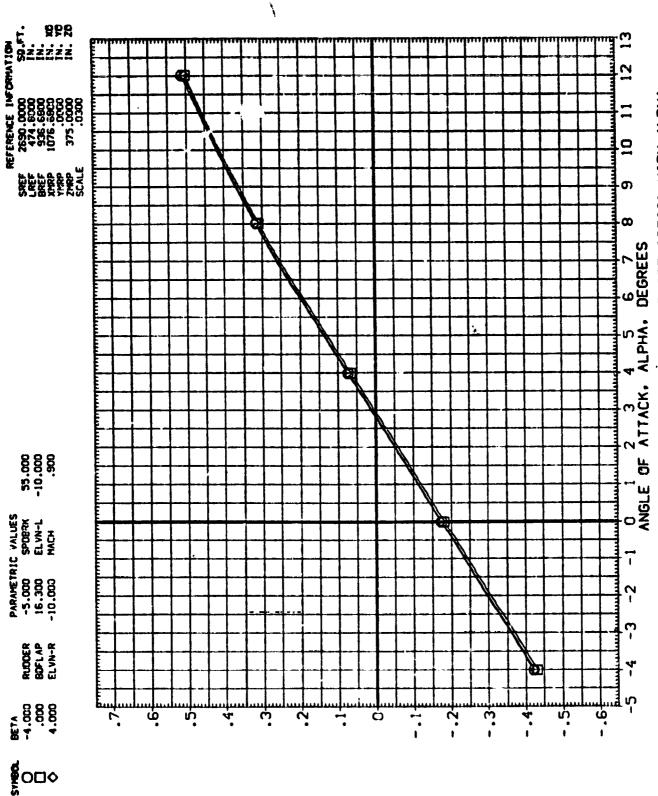
FIG. 5 VARIATION OF LONGITUDINAL RERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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PITCHING MOMENT COEFFICIENT, CLM

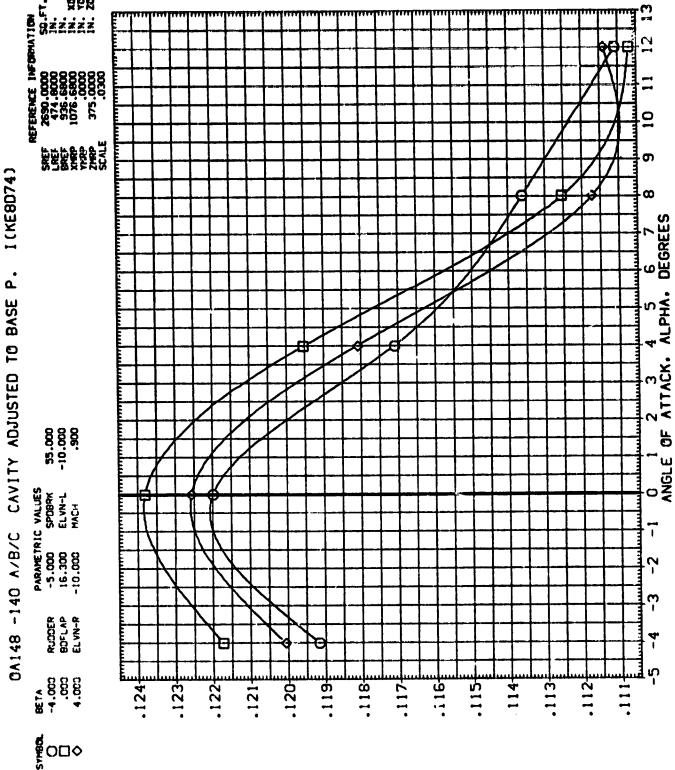
FIG. S VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



NORMAL FORCE COEFFICIENT.

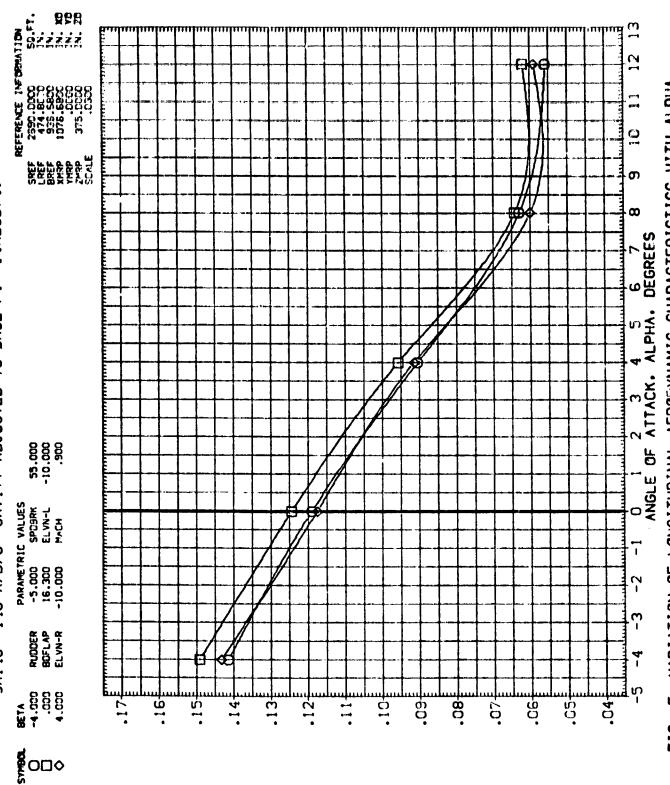
FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTENISTICS WITH ALPHA PAGE

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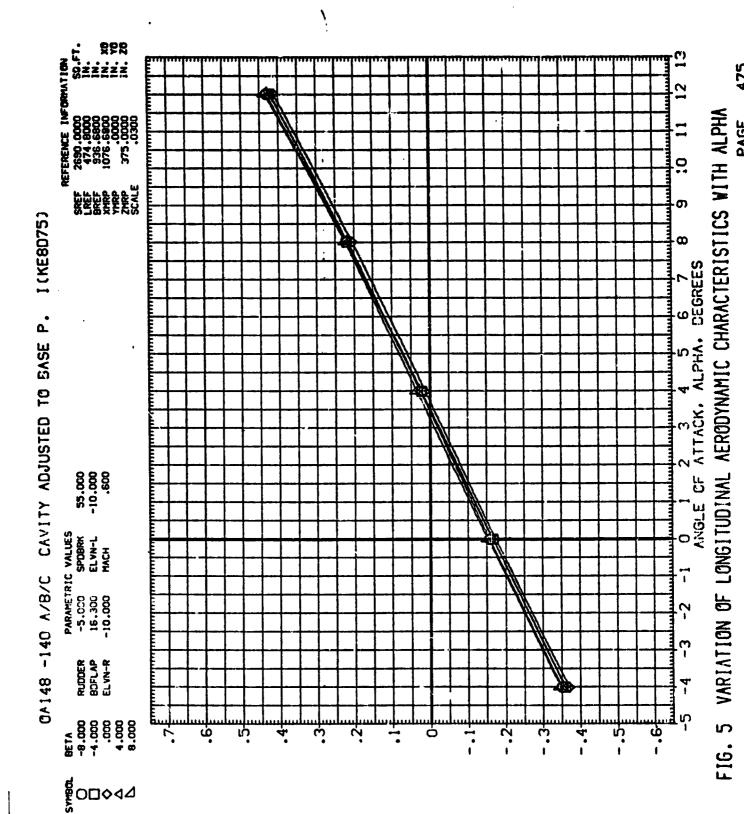
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA



PITCHING MOMENT COEFFICIENT, CLM

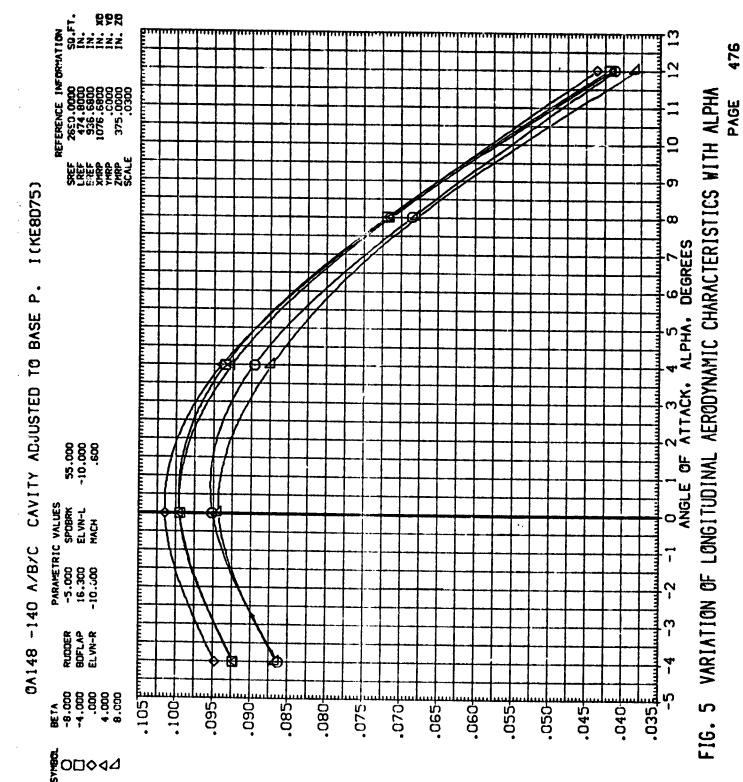
FIG. S VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

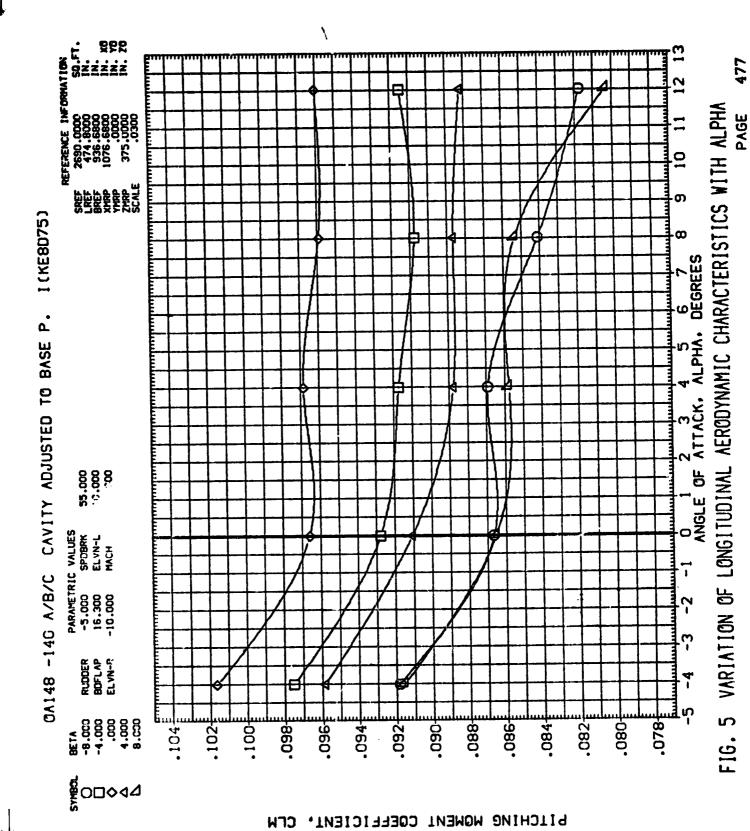


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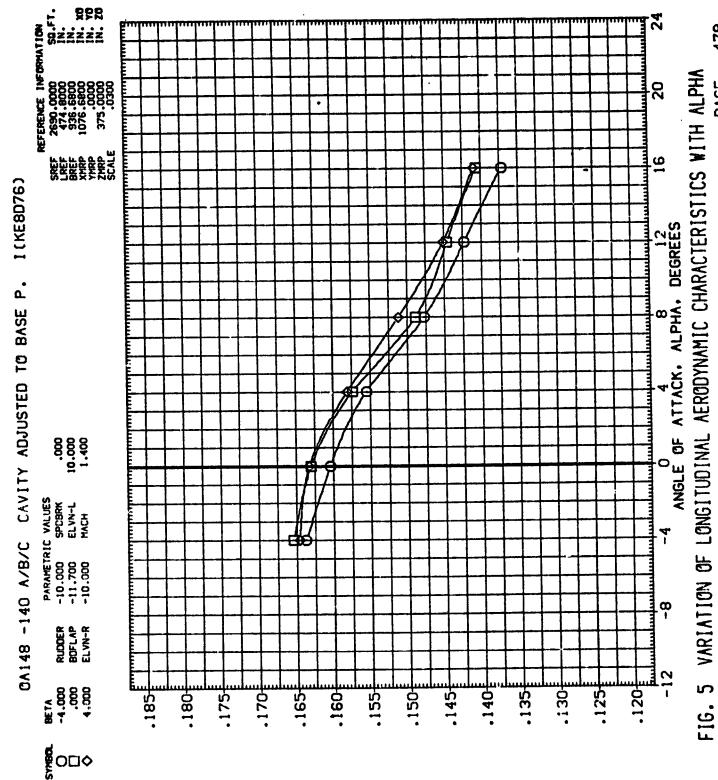


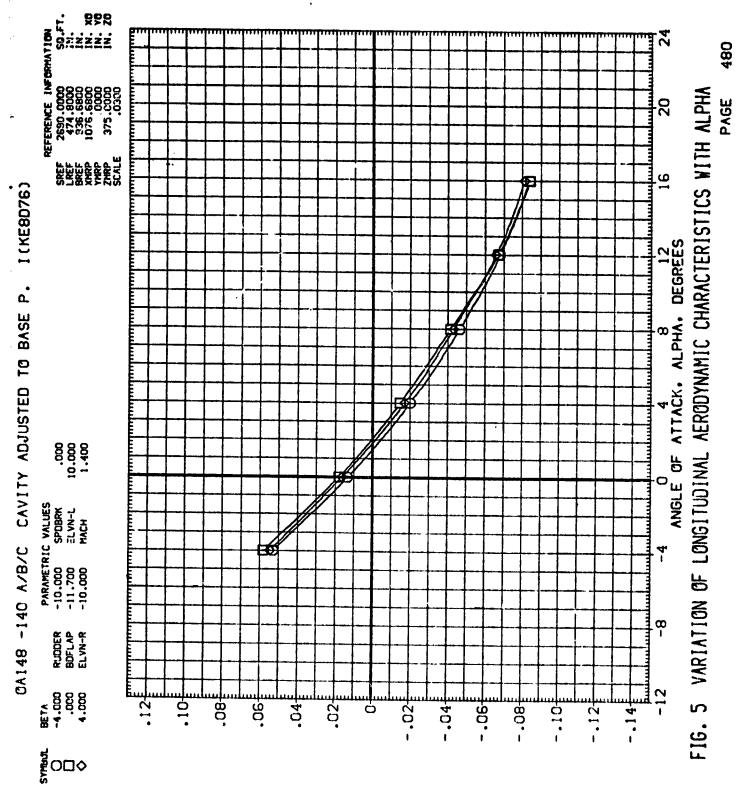
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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-11.700 ELVN-L
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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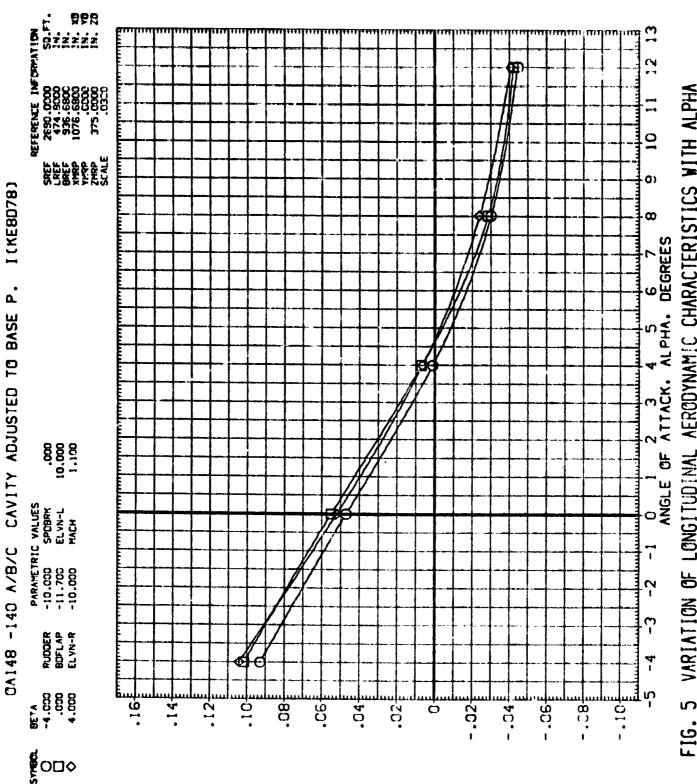
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1. 1076.0000 IN. 8 12 0 SCALE တ I (KE8078) œ O 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES CAVITY ADJUSTED TO BASE P. .000 10.000 1.100 PARAMETRIC VALUES -10.000 SPOBRK -11.700 ELVN-L GA148 -140 0/8/C 7 RUDDER BOFLAP ELVN-R .144E -4.030 .000. 166年 .172E 170年 .168£ .162<del>[</del> 160年 158 .150長 .148 .164 .146 .156 154 .152 ¥O□¢

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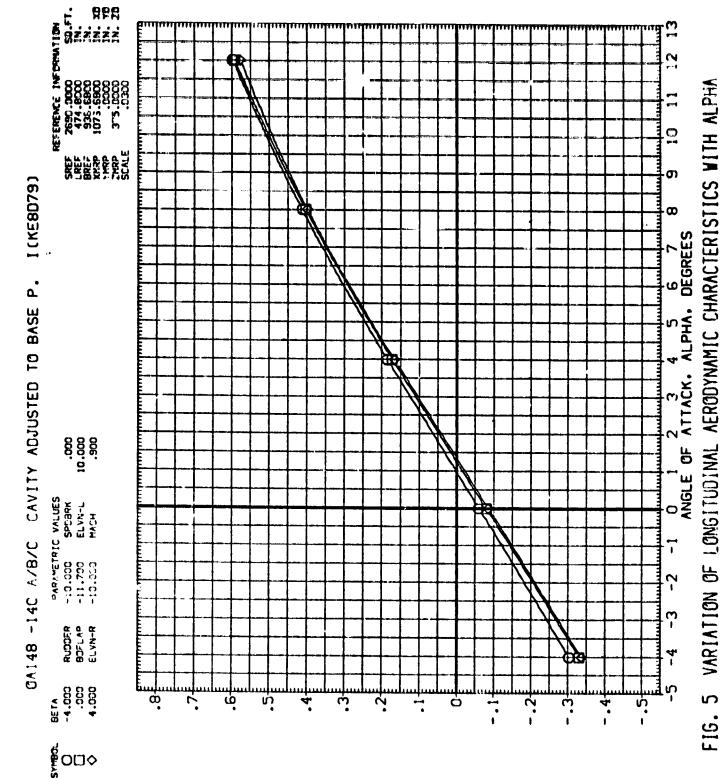
FIG. S VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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PITCHING MOMENT COEFFICIENT, CLM

FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE



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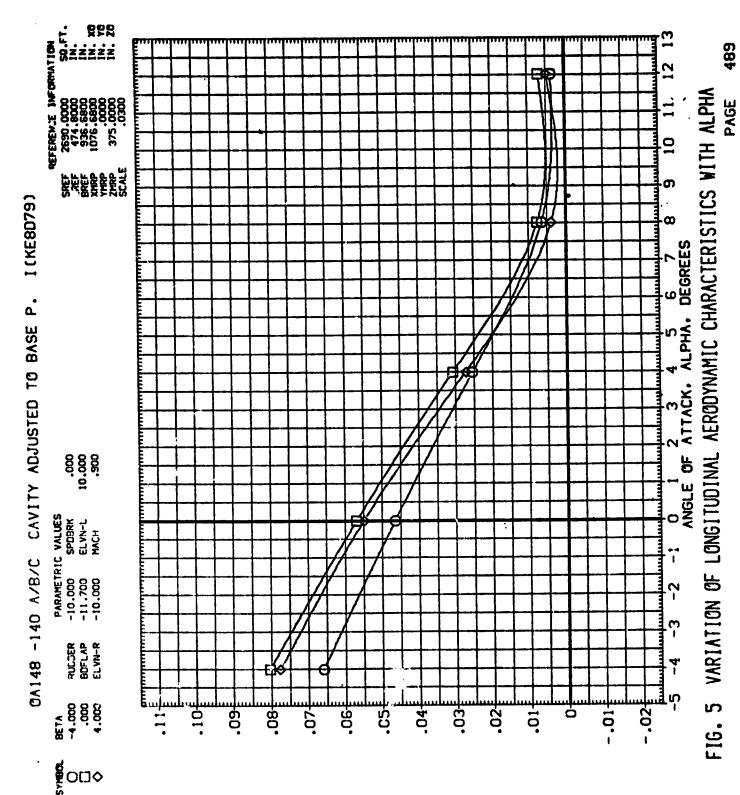
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

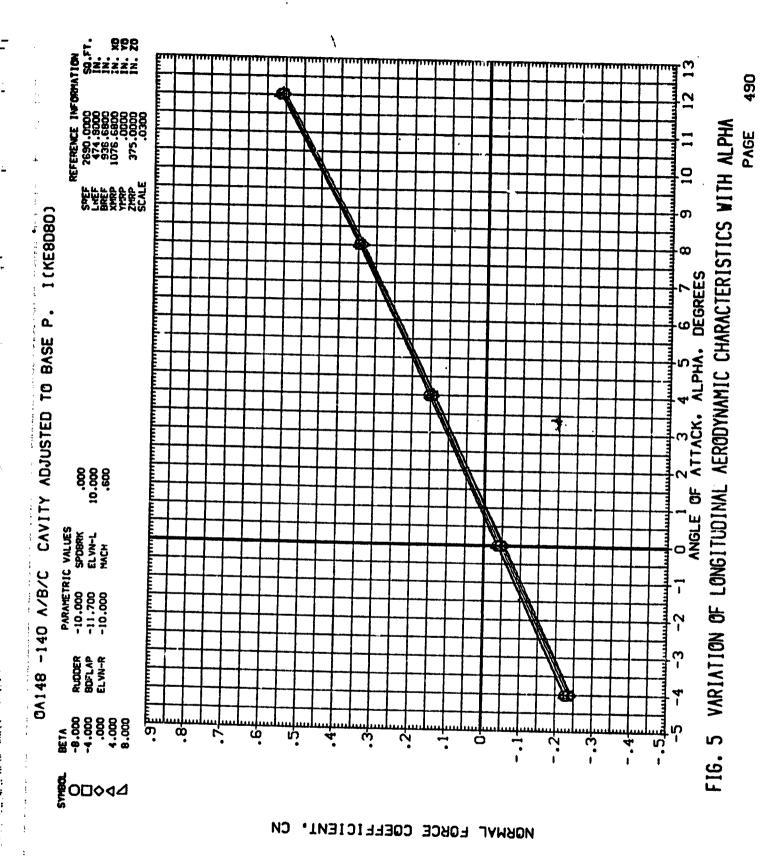
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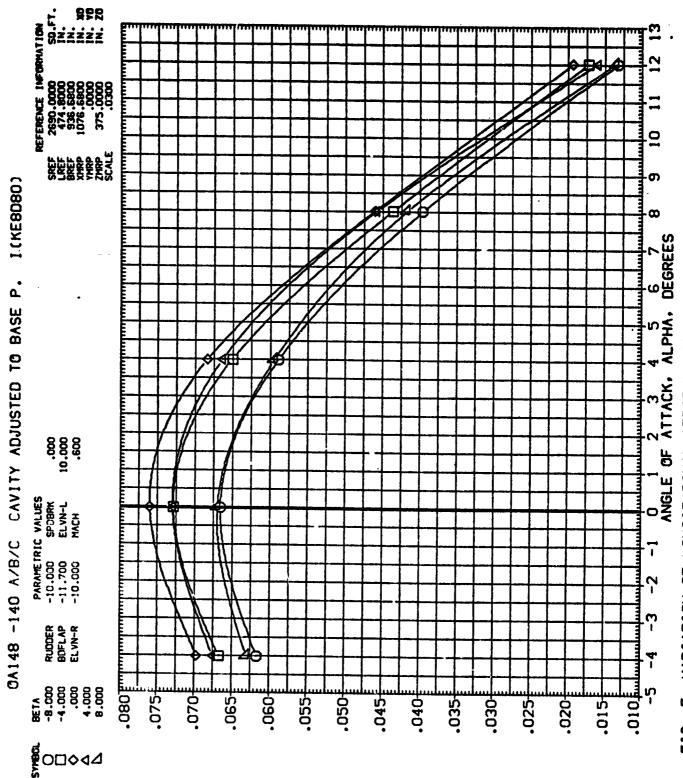
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AERODYNAMIC CHARACTERISTICS WITH ALPHA FIG. 5 VARIATION OF LONGITUDINAL

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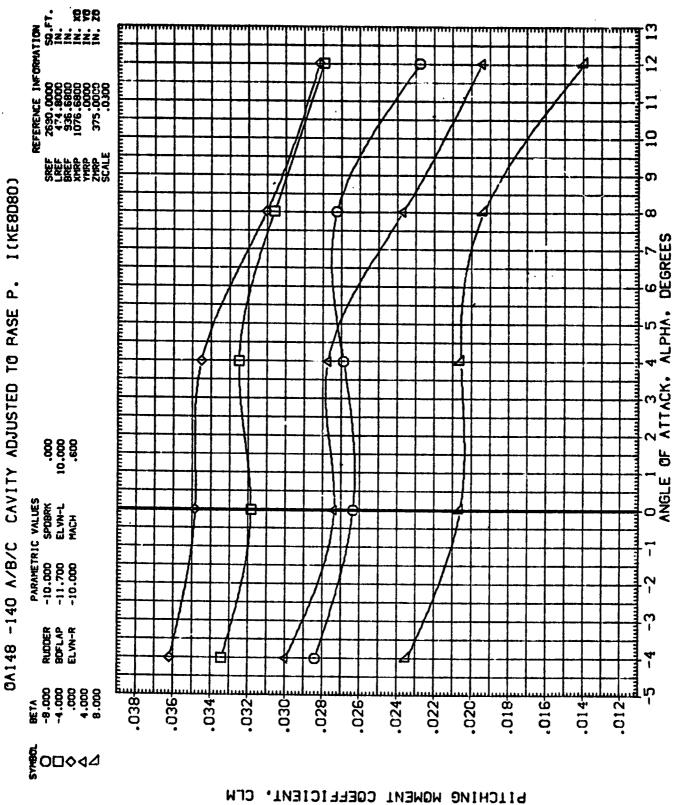
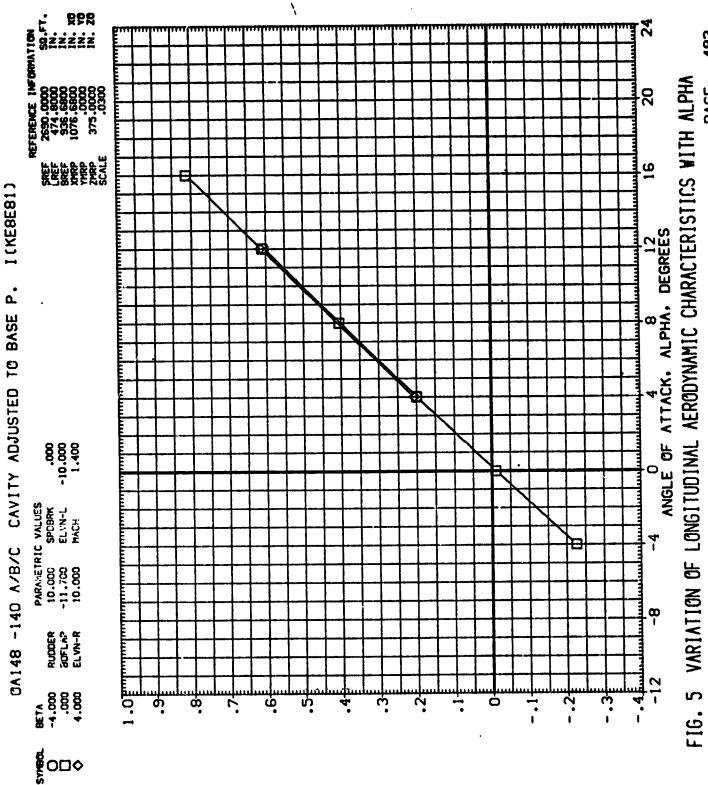
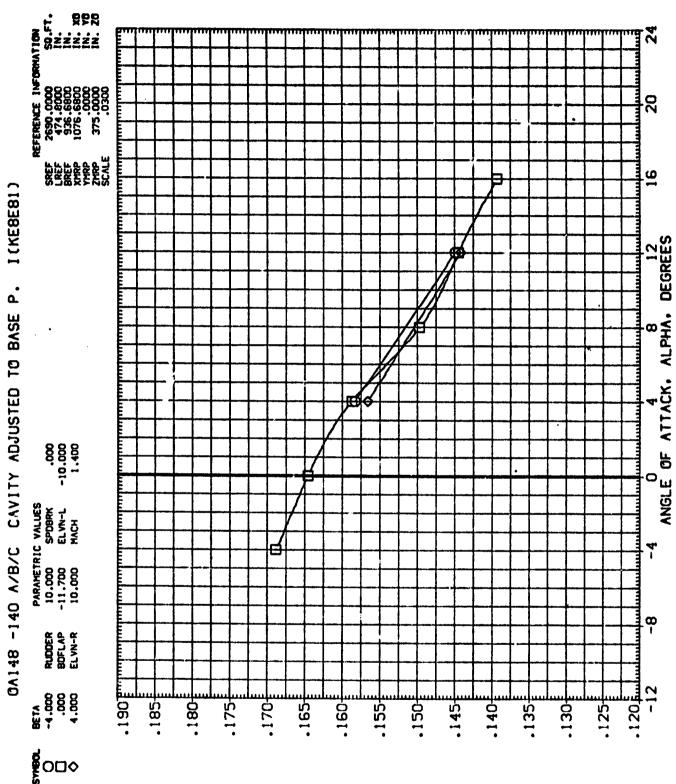


FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE

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NORMAL FORCE COEFFICIENT,



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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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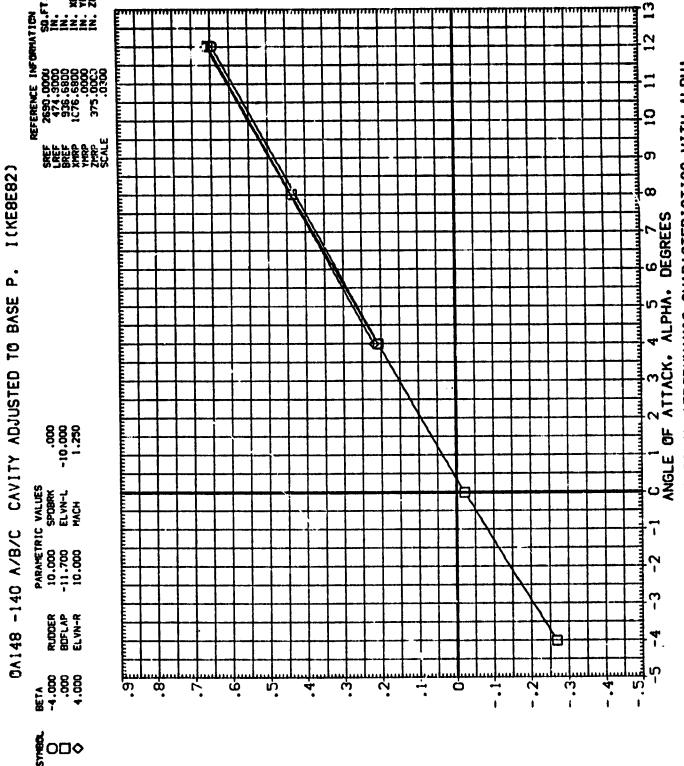
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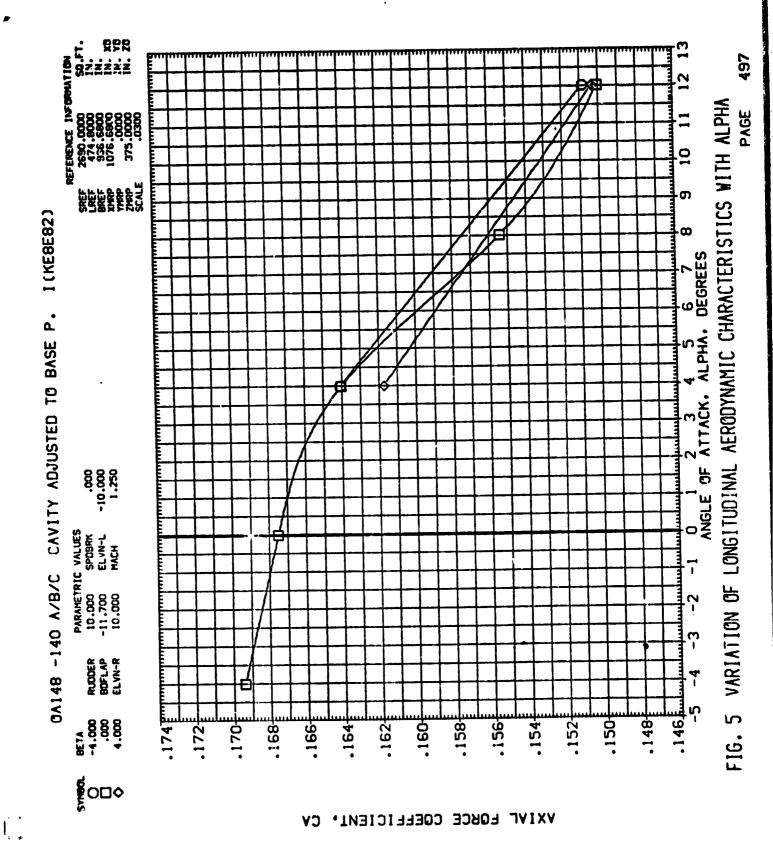
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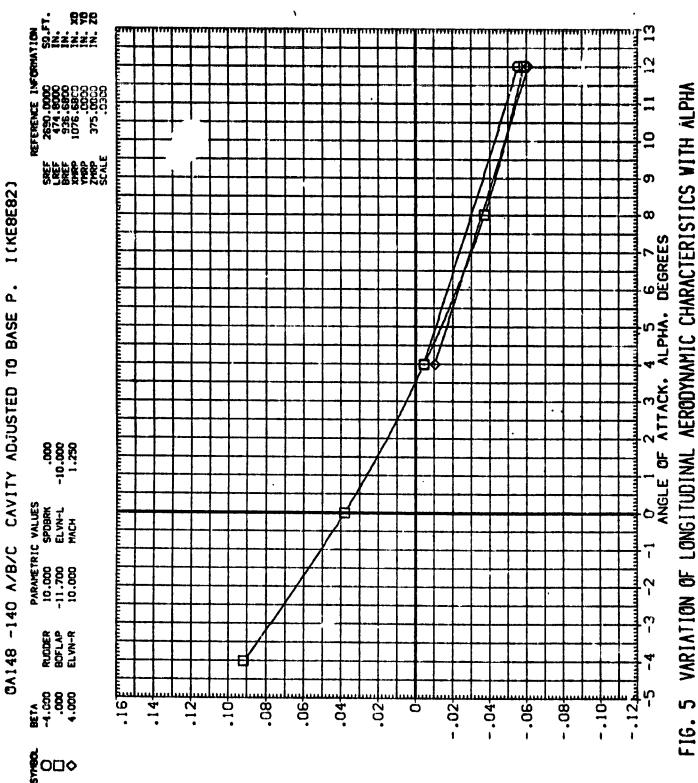
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA





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RUDDER BOFLAP ELVN-R

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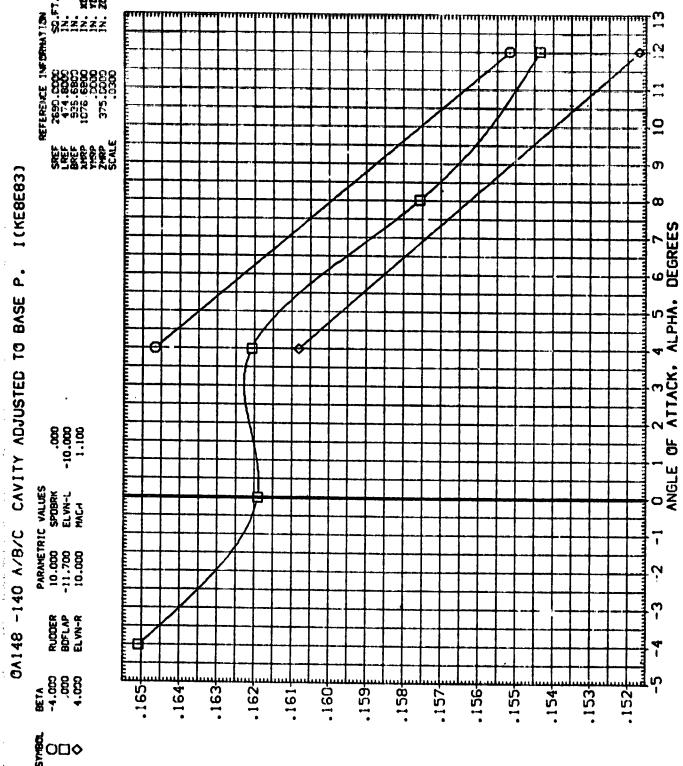
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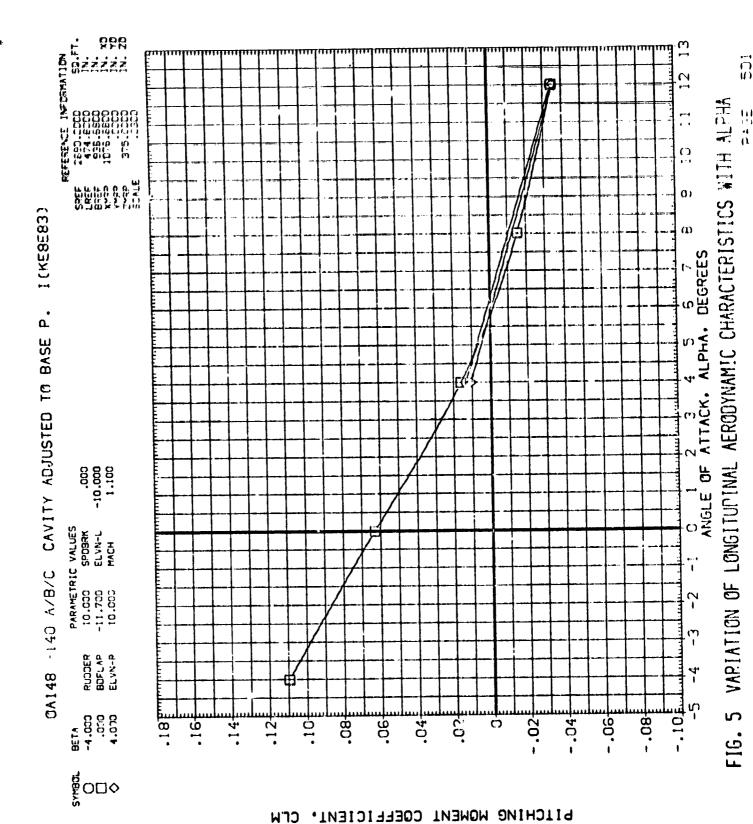
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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

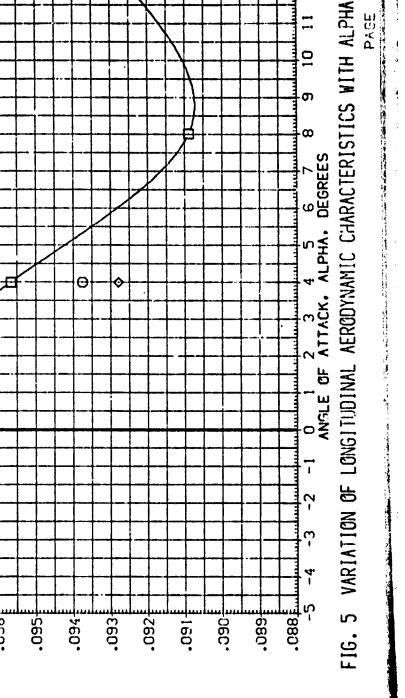


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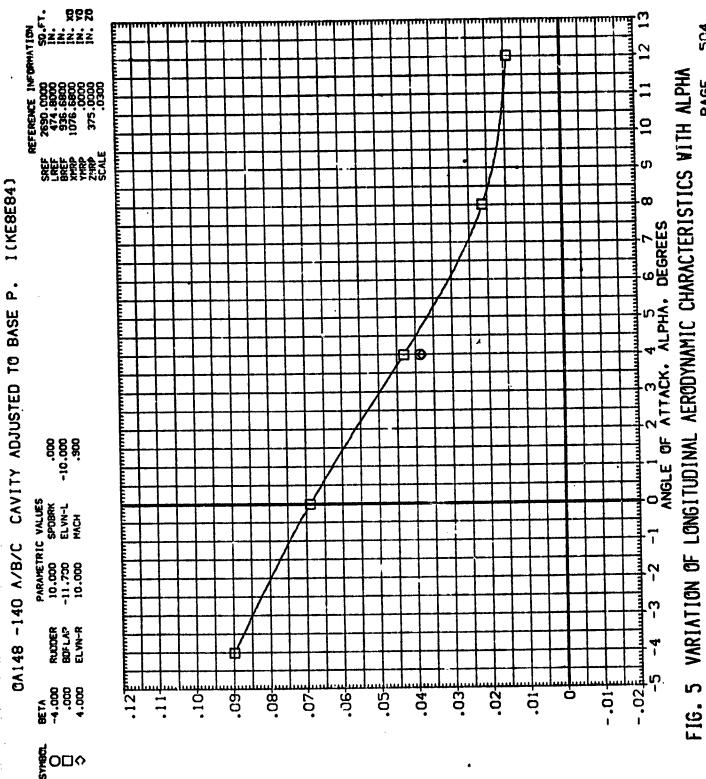
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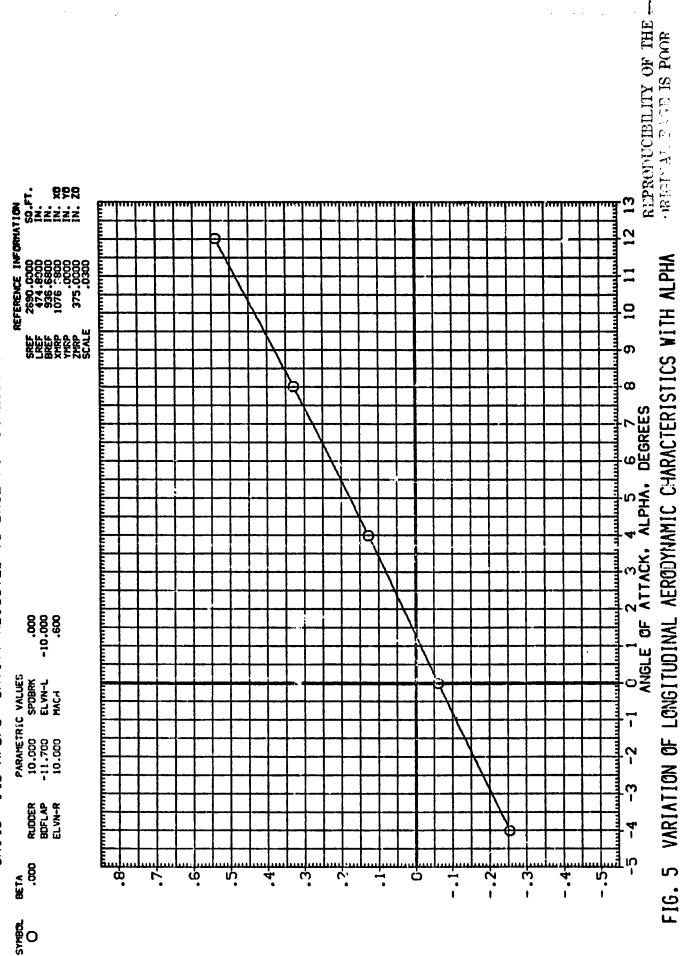


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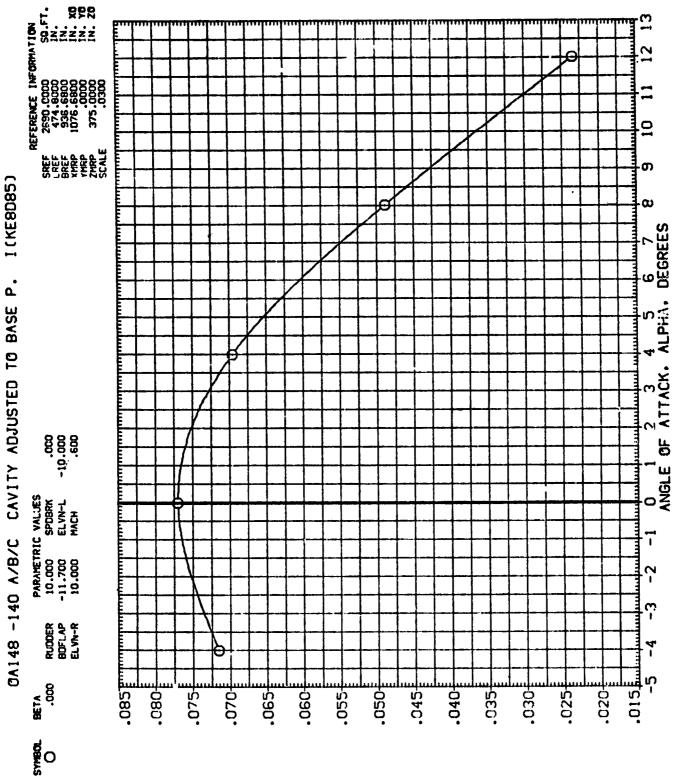


DA148 -140 A/B/C CAVITY ADJUSTED TO BASE P. I (KE8D85)



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FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA

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REFERENCE INFORMATION
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... 507 12 FIG. 5 VARIATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS WITH ALPHA PAGE 0 SAEF LREF YARP ZARP SCALE တ Φ uquumuquumuquumuquuluuquud 0 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES .000.01-.600.000. PARAMETRIC VALUES 10.000 SPDBRK -11.703 ELVN-L 10.000 MACH 7 OA148 -140 A/9/C 7. က RUDDER BOFLAP ELVN-R Ŋ .046 mg -033 .034長 .043론 .042長 .040年 .035 .038£ .036<del>-</del> 9£1A .000 .041長 .039 .037 .045 .044 SYMBOL O

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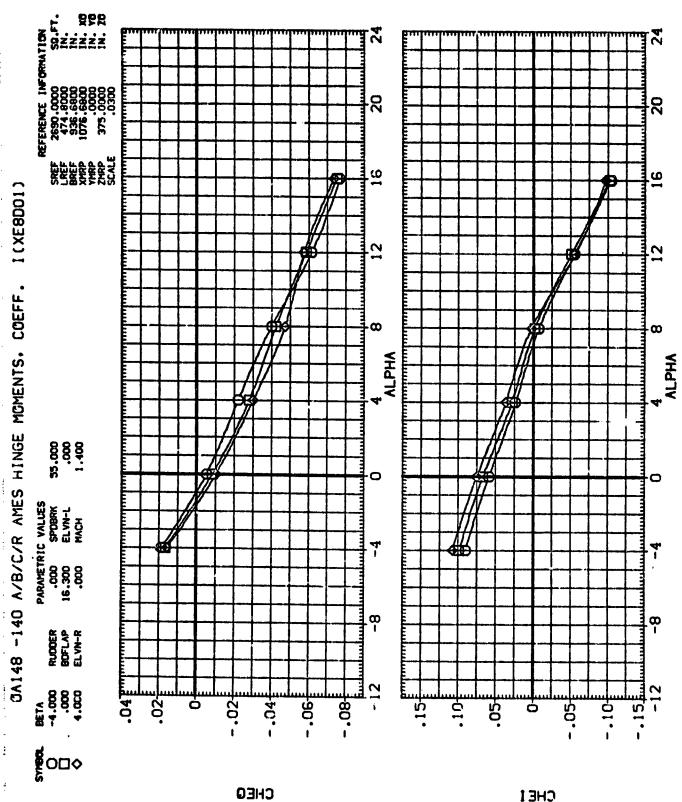
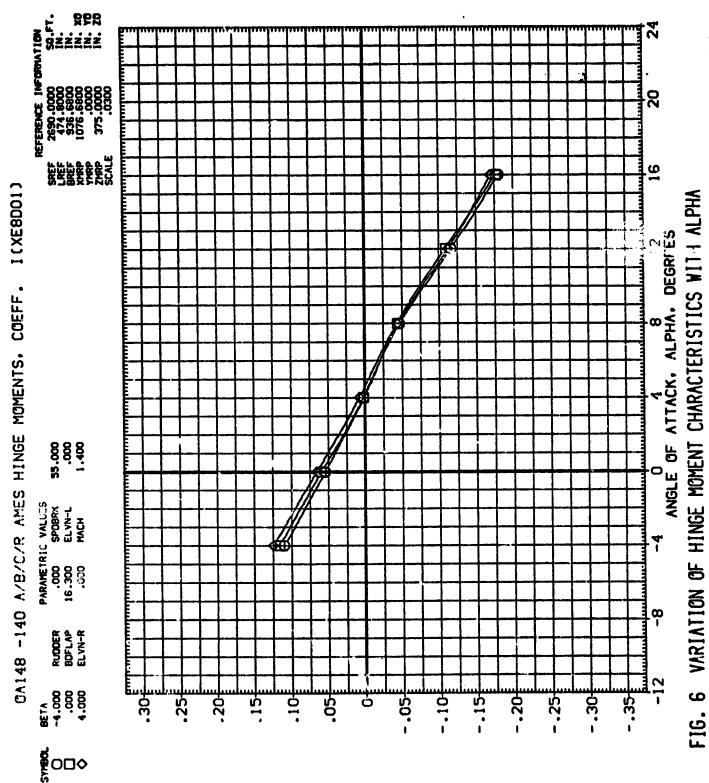


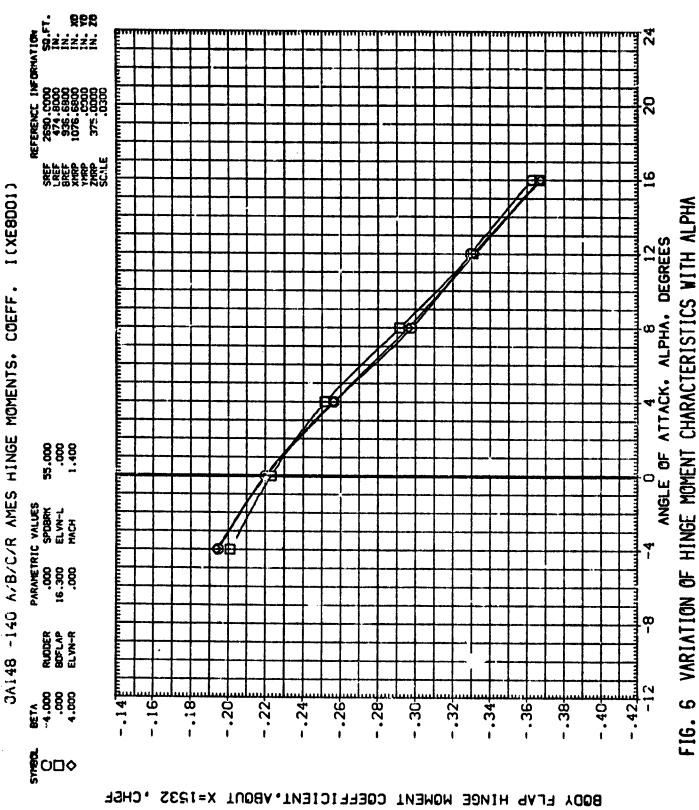
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

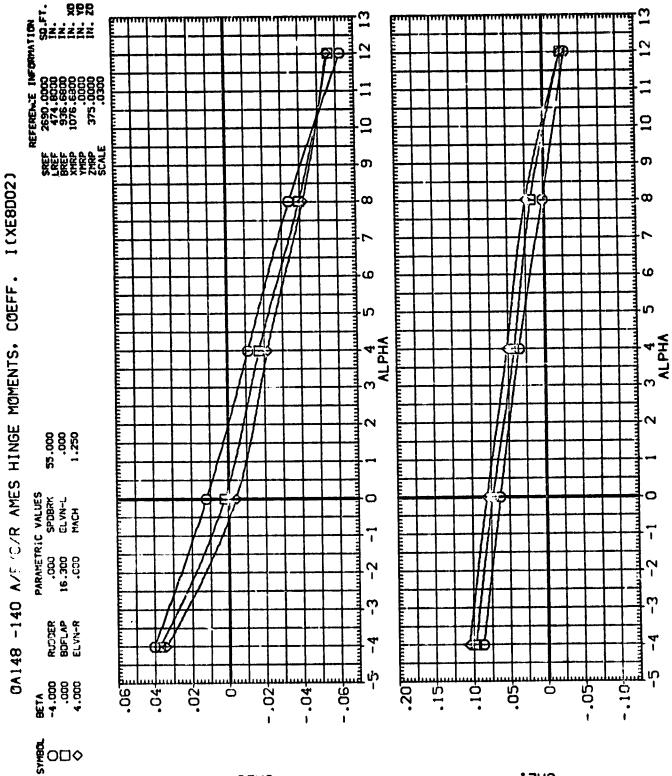
508 PAGE

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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT



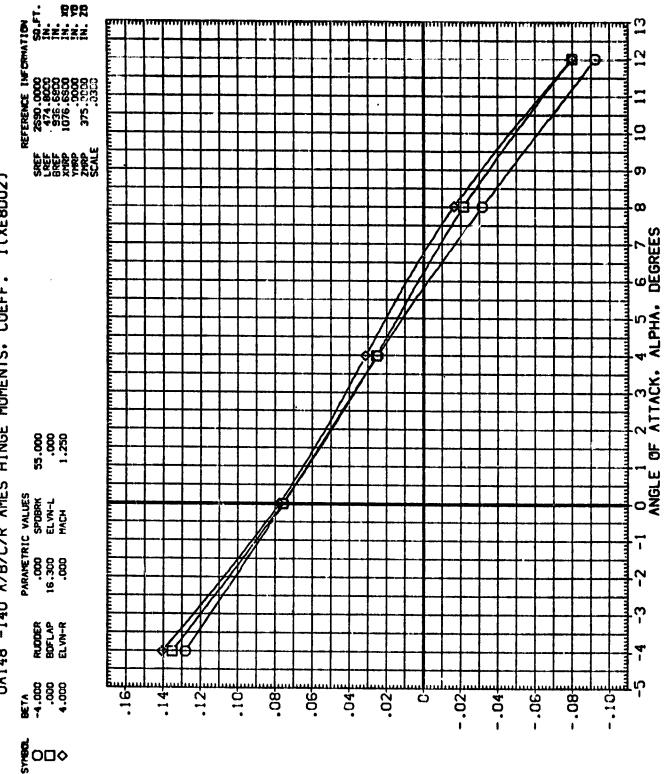


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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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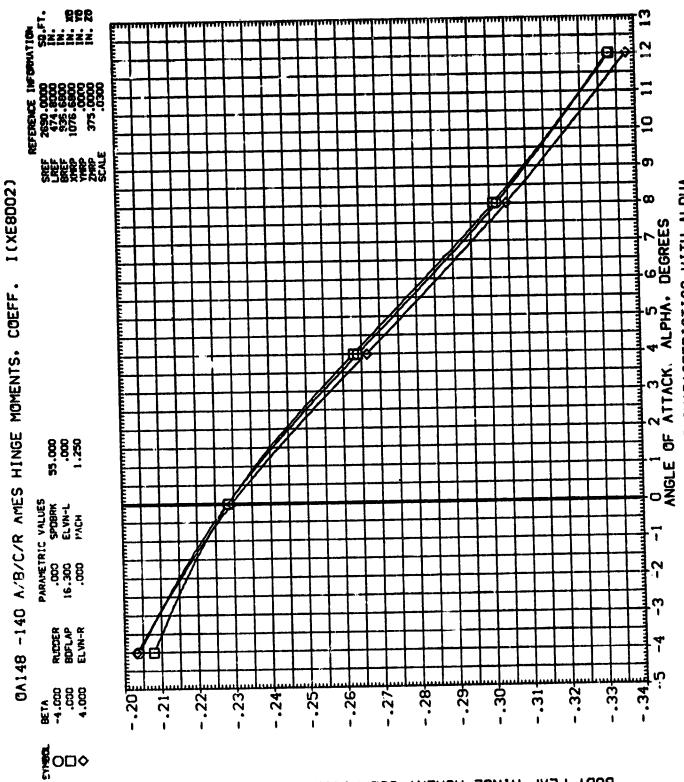


TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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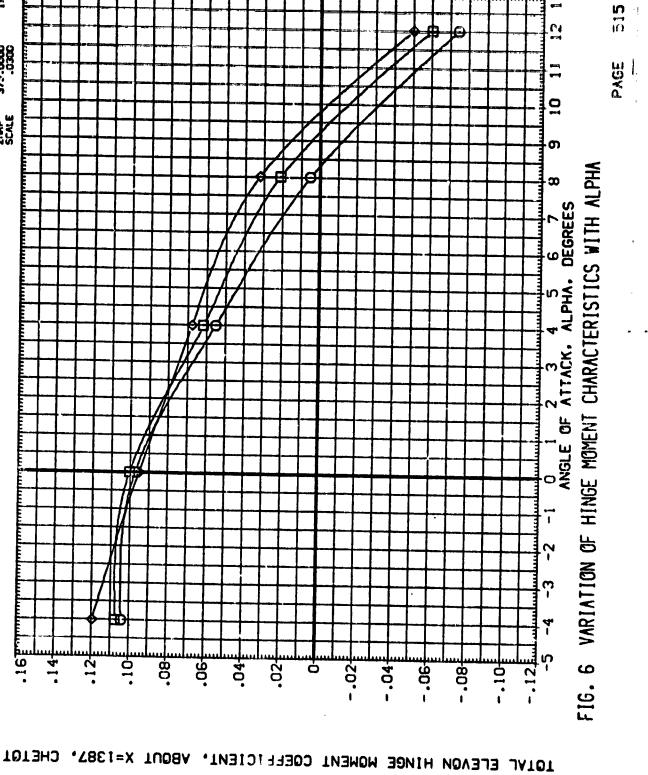
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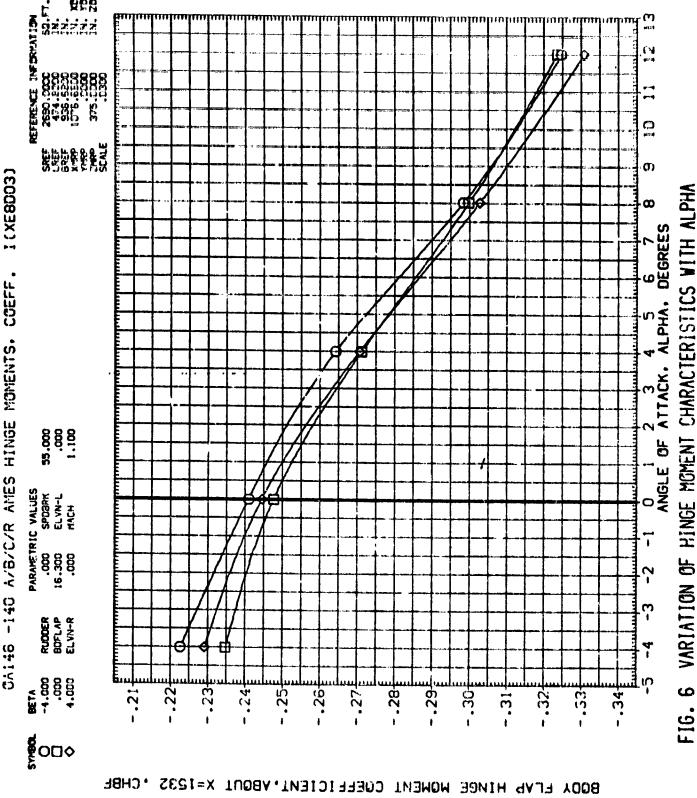
PARAMETRIC VALUES .000 SPOBRY 16.300 ELVN-L .000 MACH

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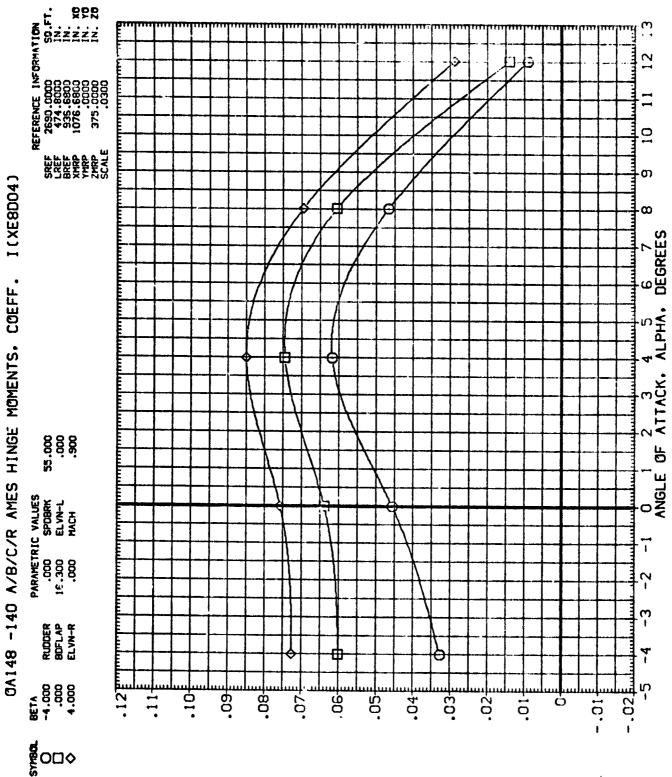
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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SO FT. REFERENCE INFORMATION 2690.0000 474.8000 936.6800 1076.6800 375.0000 0 SREF LREF BREF XMRP YNRP ZMRP SCALE ത 1 CXE8D04) 2 3 4 5 6 7 ATTACK, ALPHA, DEGREES CA148 -140 A/B/C/R AMES HINGE MOMENTS. COEFF. 55.000 .000 .900 O 1 ANGLE OF PARAMETRIC VALUES
.000 SPCBRX
16.300 ELVN-L
.000 MACH 7 RUDDER BOFLAP FLVN-R -.160 9£14 -4.000 .000 4.000 -.162<u></u> -.164€ -.172 -.174 -.178 -.182 -.168 -.176 -.166--.170 -.180 -.184 -.186 **§**O□◊

PAGE

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

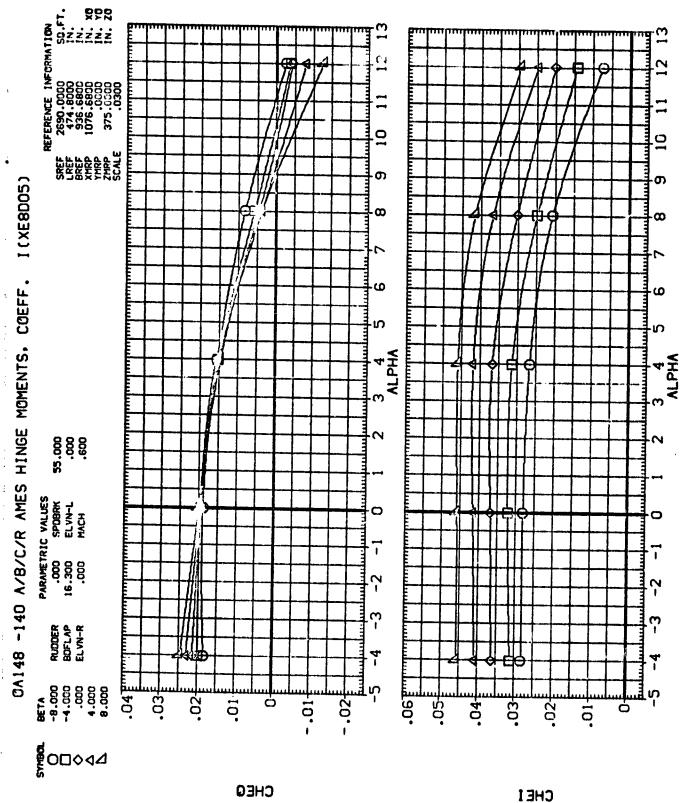
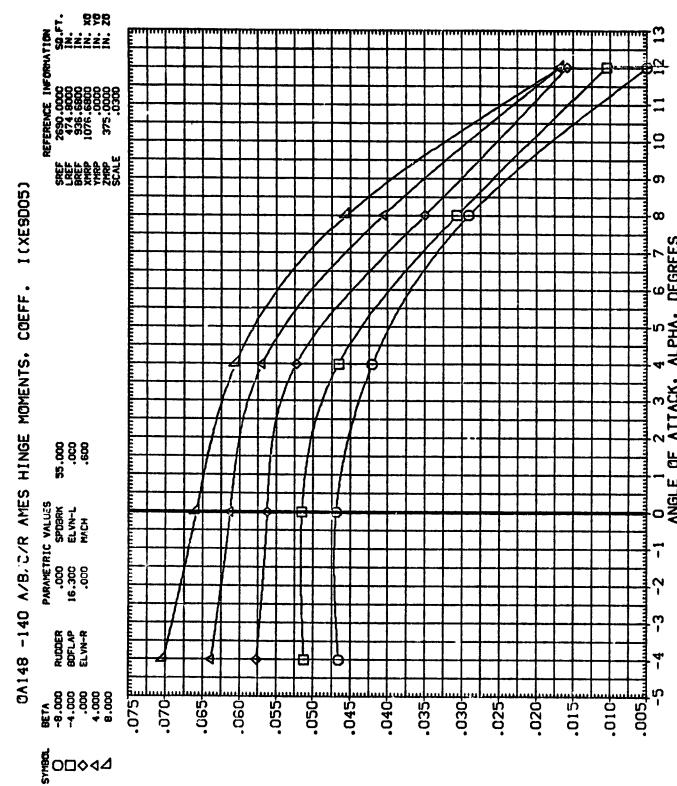


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

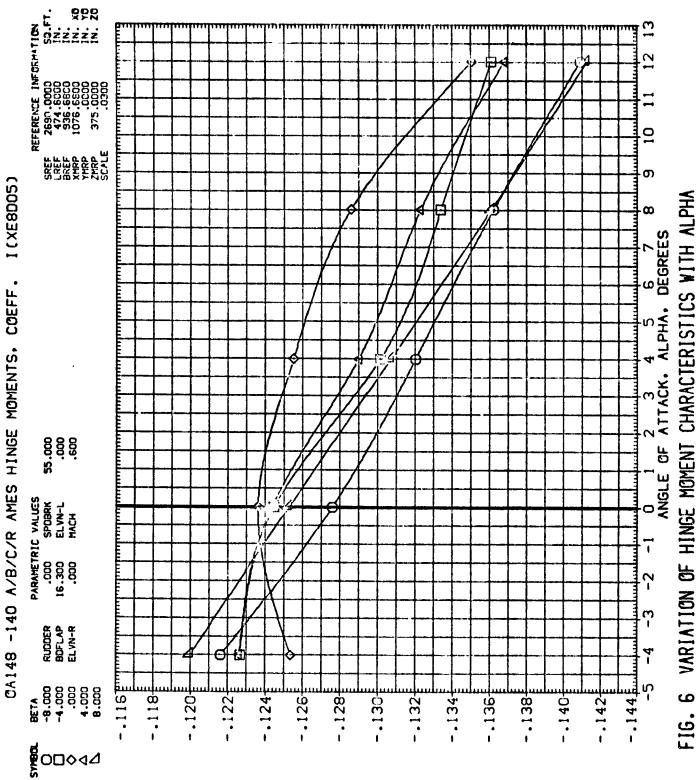
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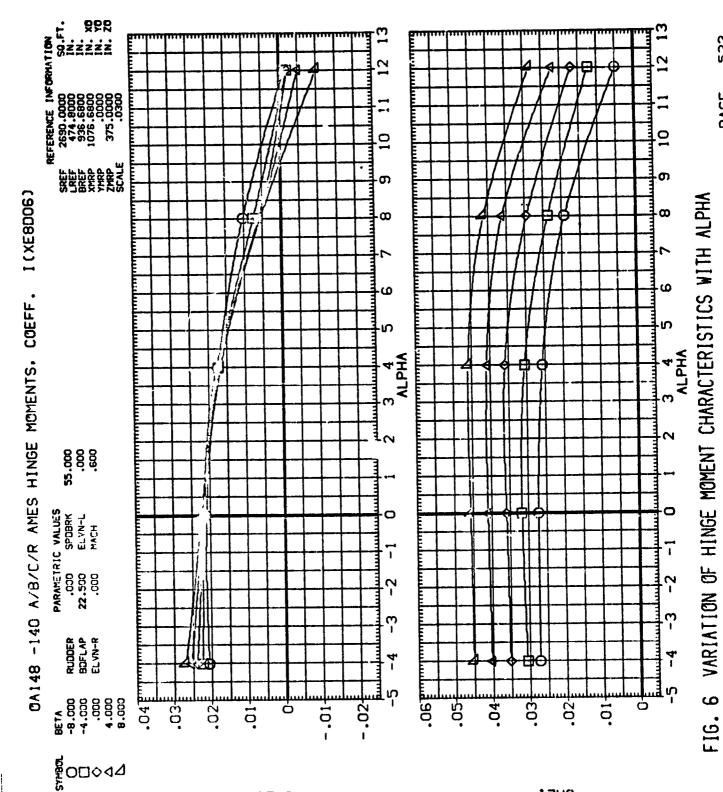
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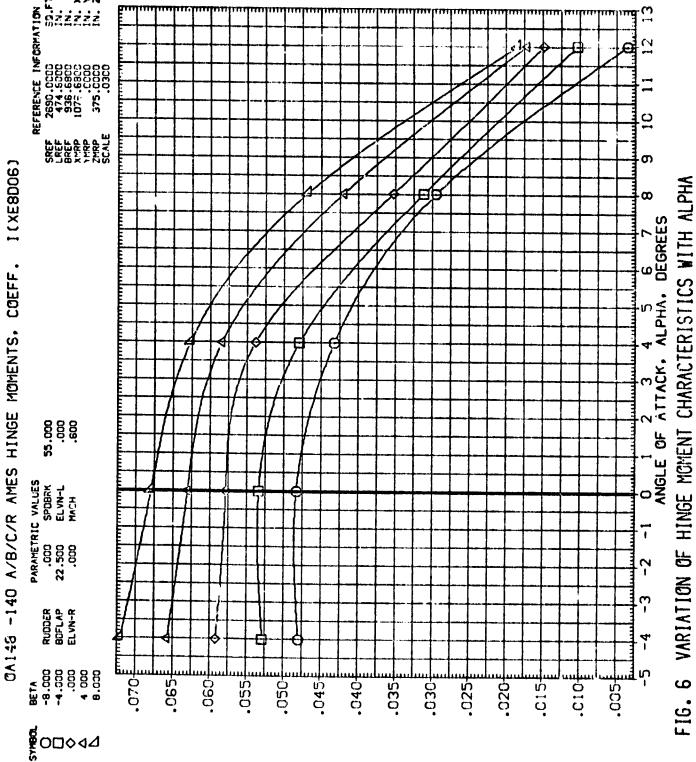
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT





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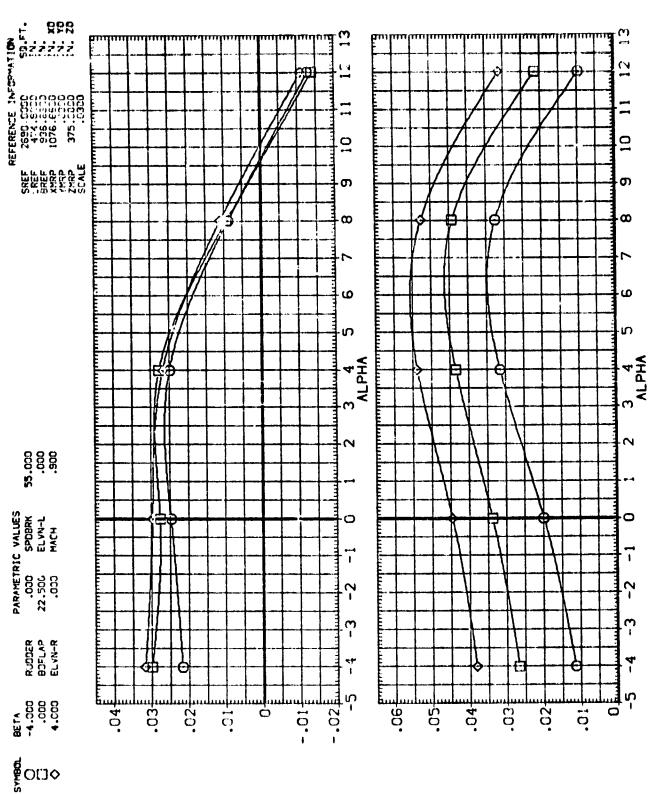
BODY FLAP HINGE MOMENT CUEFFICIENT, ABOUT X=1532 , CHBF

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FIG. 6 VARIATION OF HINGE MOMENT CHARACIERISTICS WITH ALPHA

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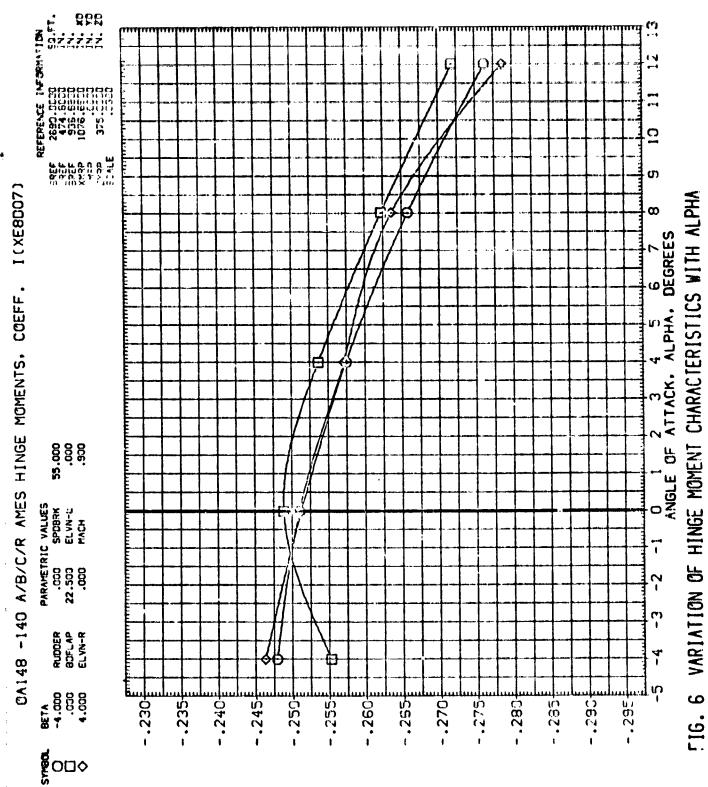
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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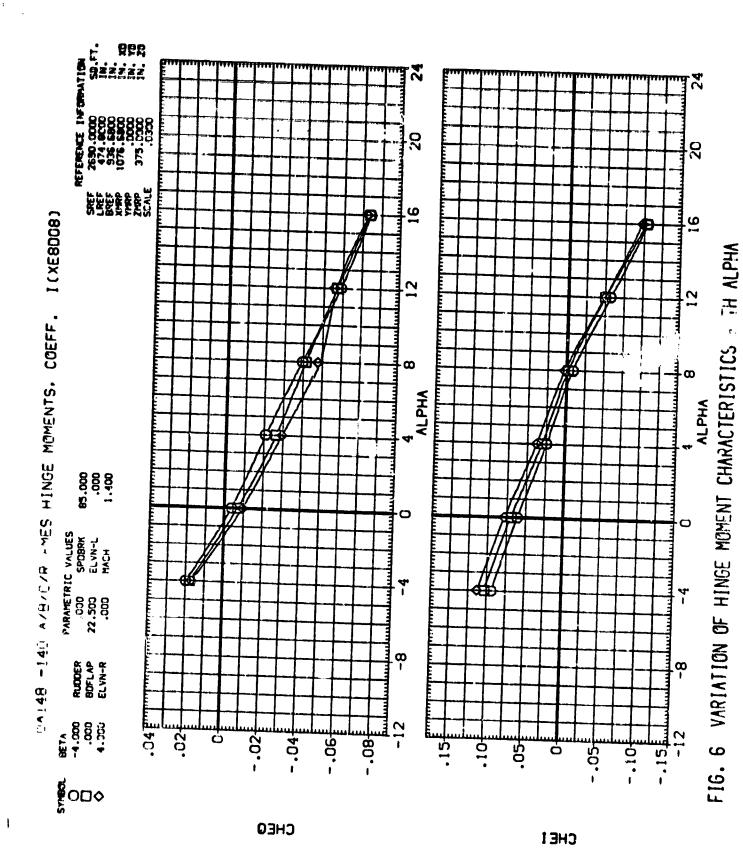
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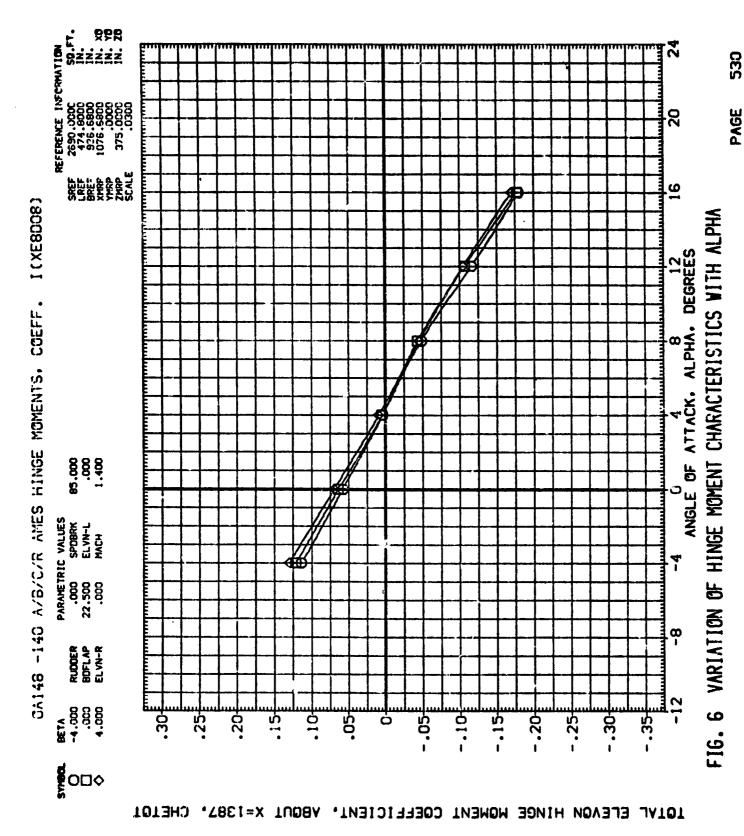


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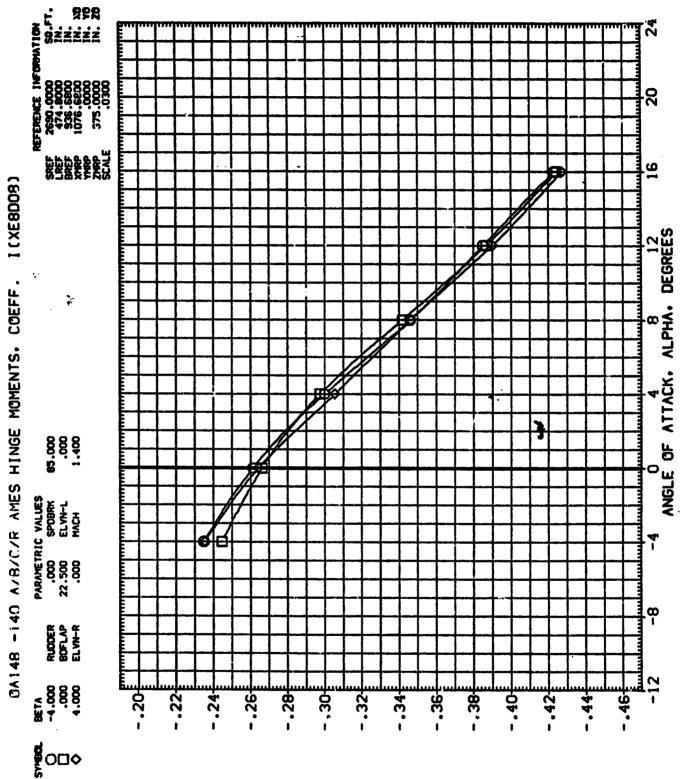


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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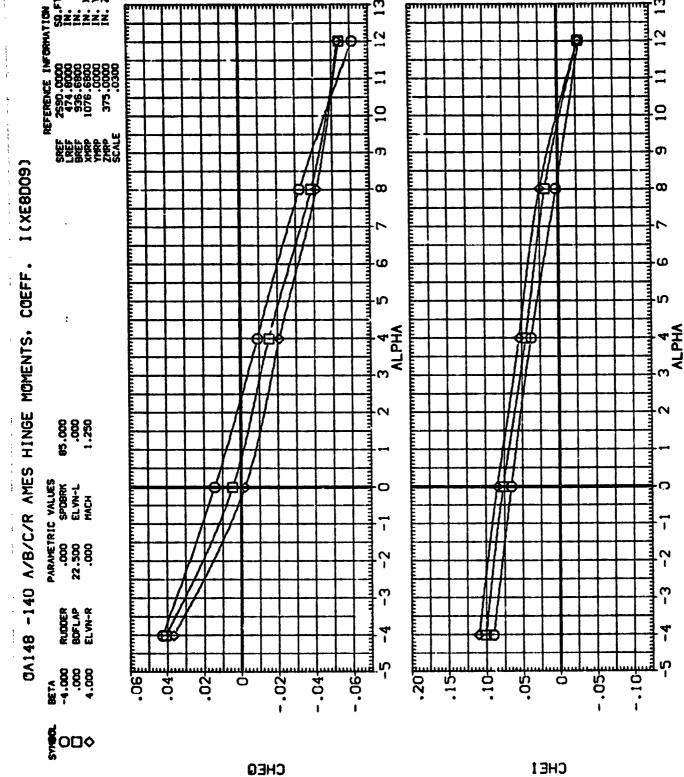


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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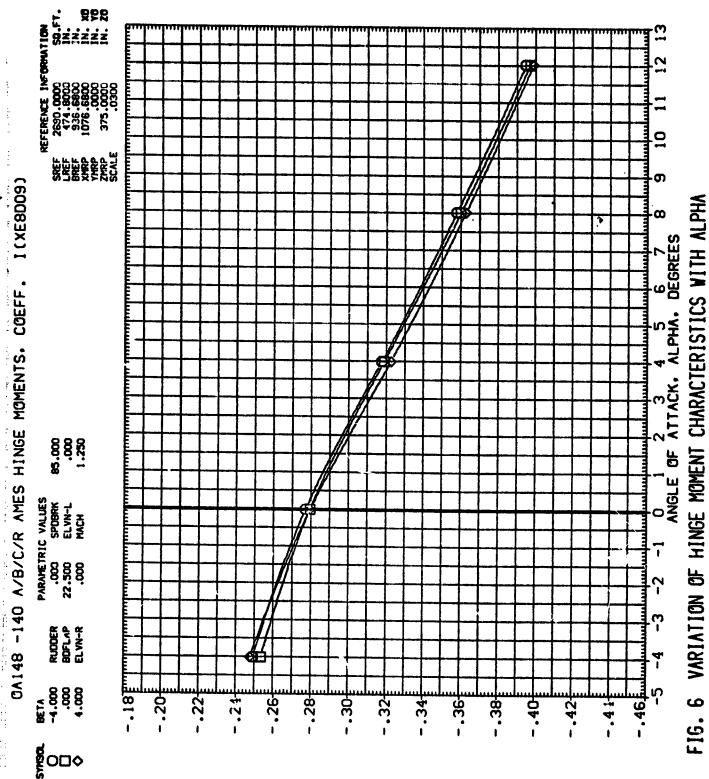
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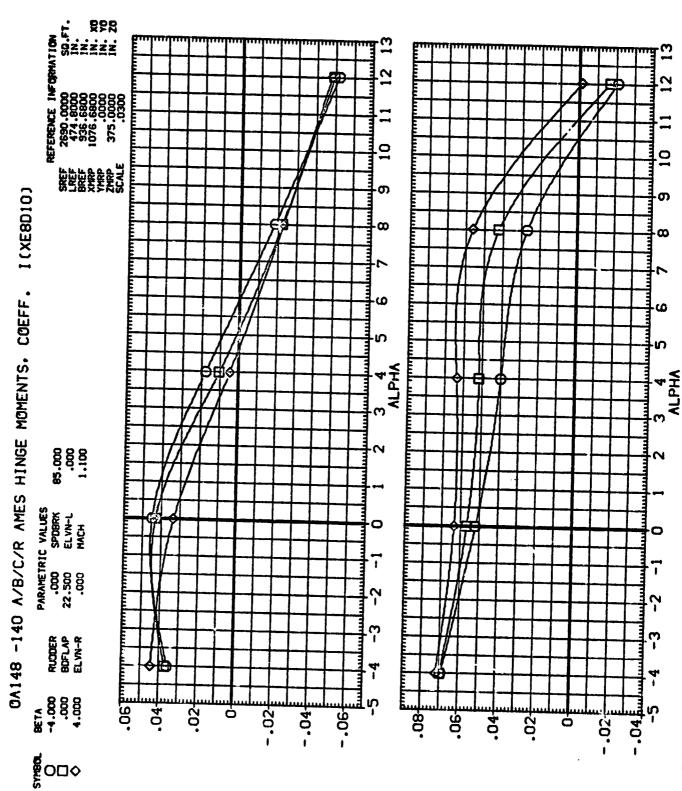


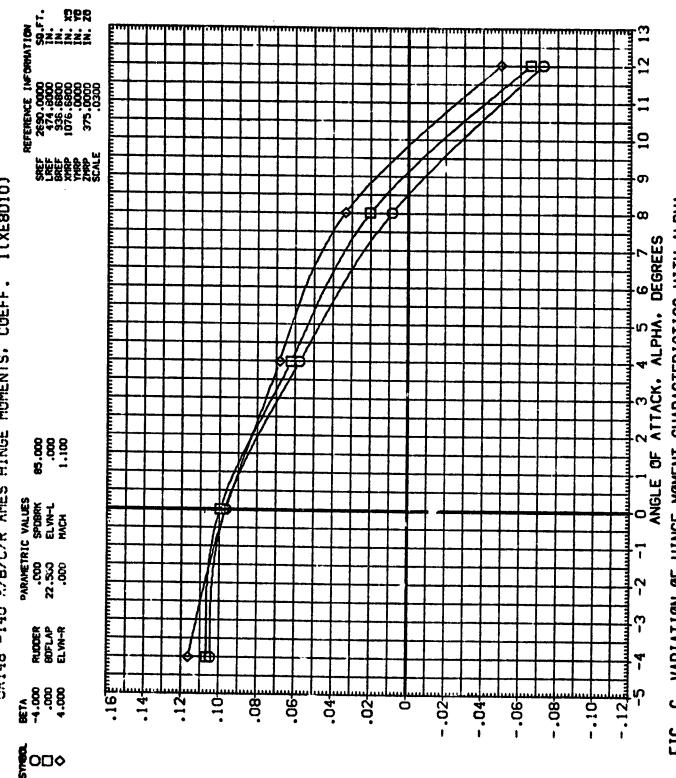
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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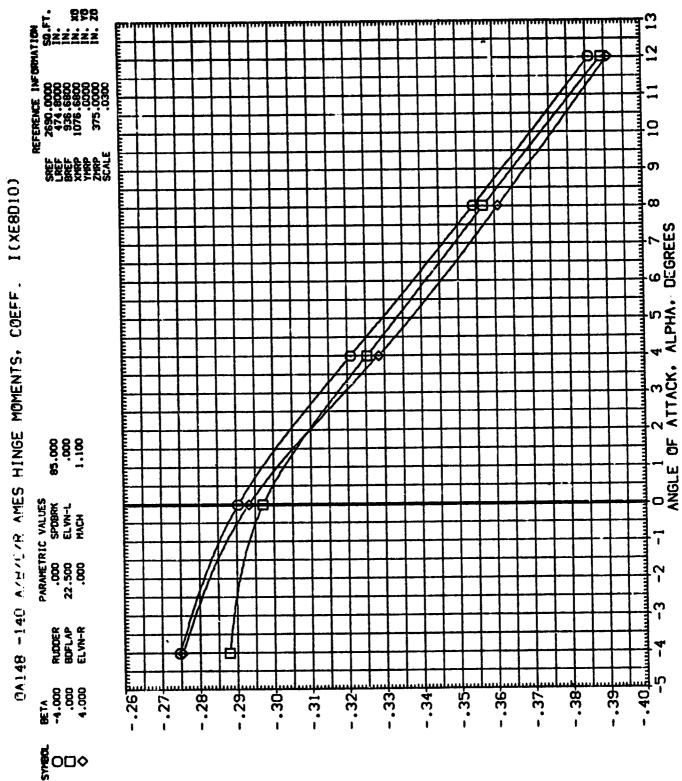
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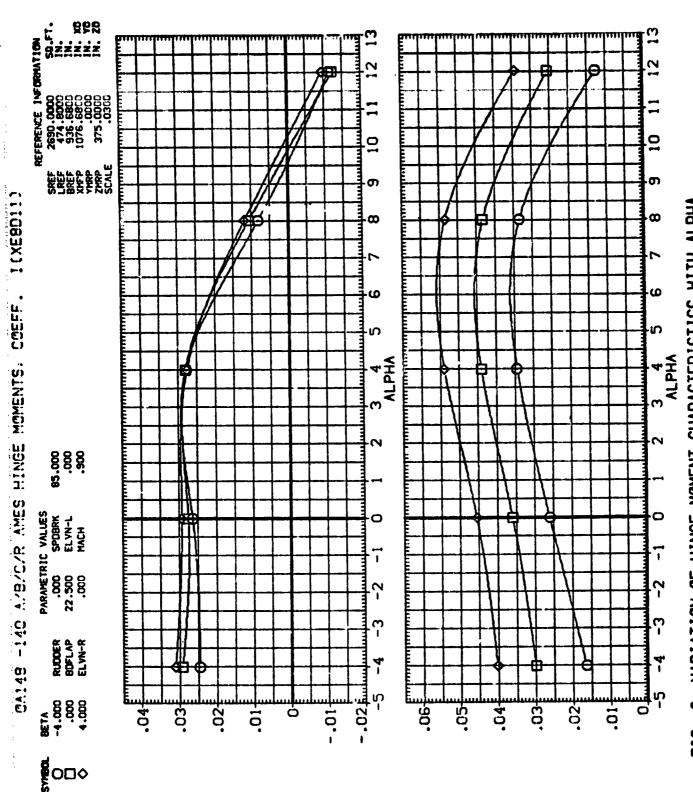


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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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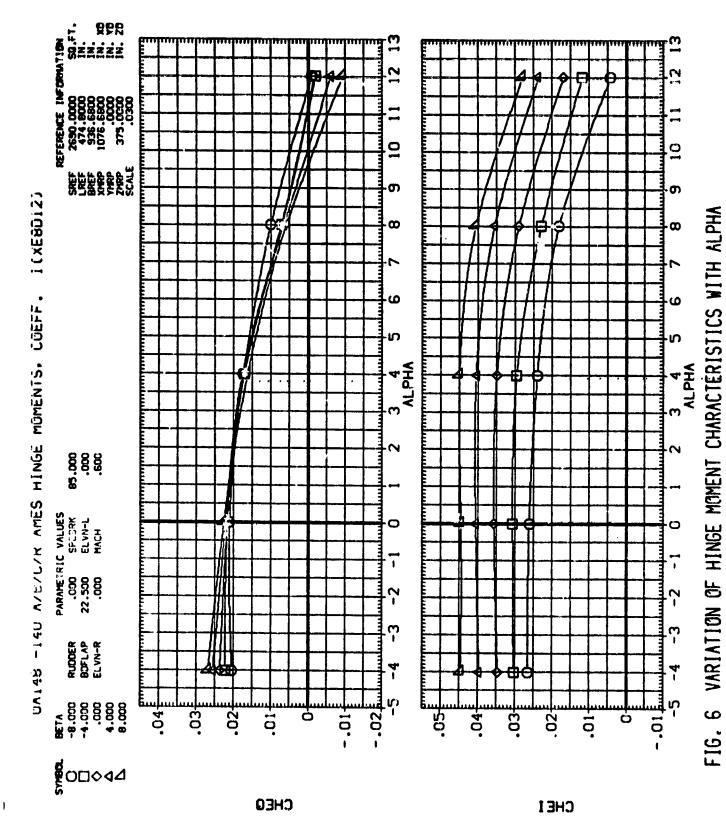
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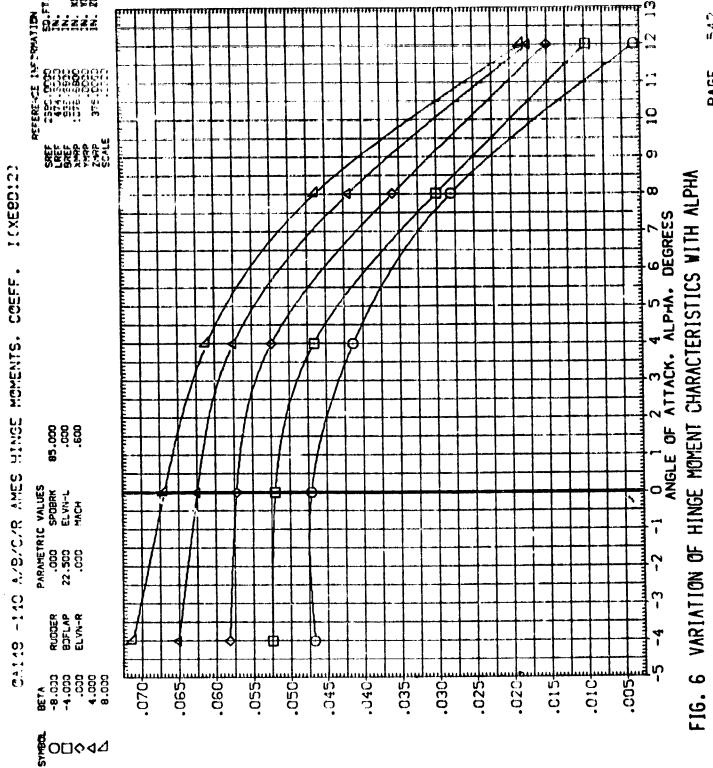
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

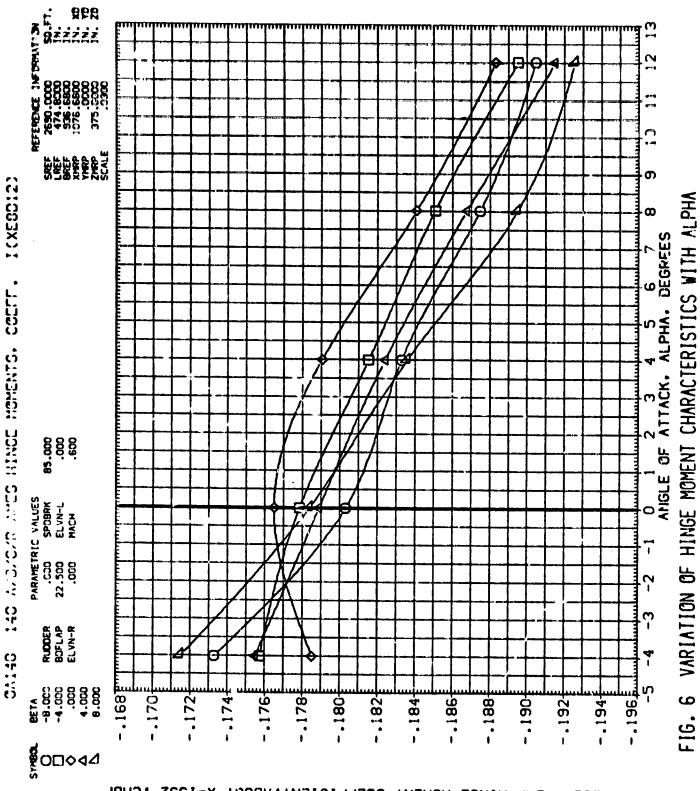
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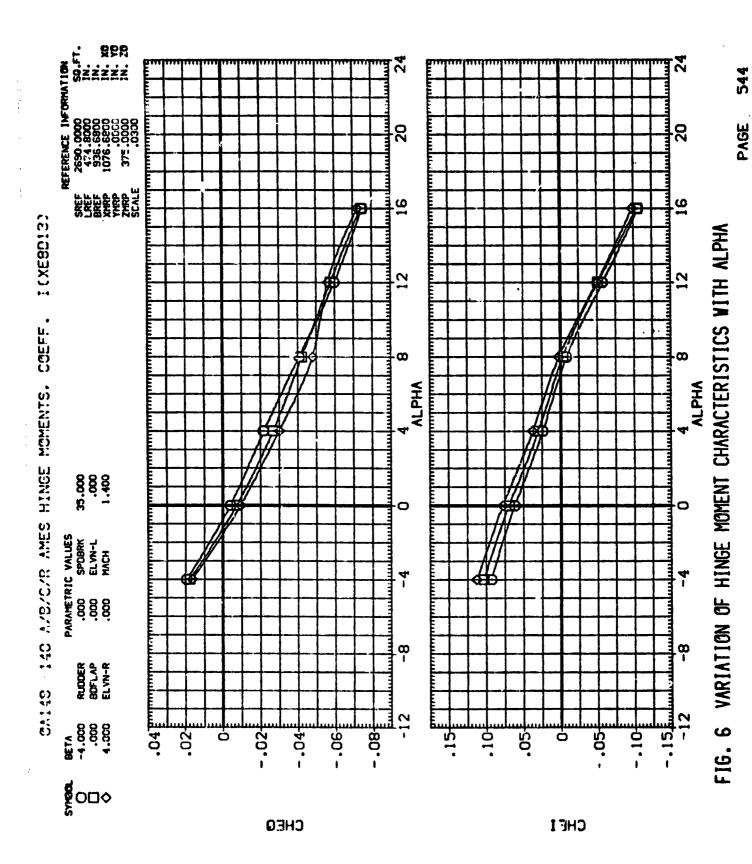


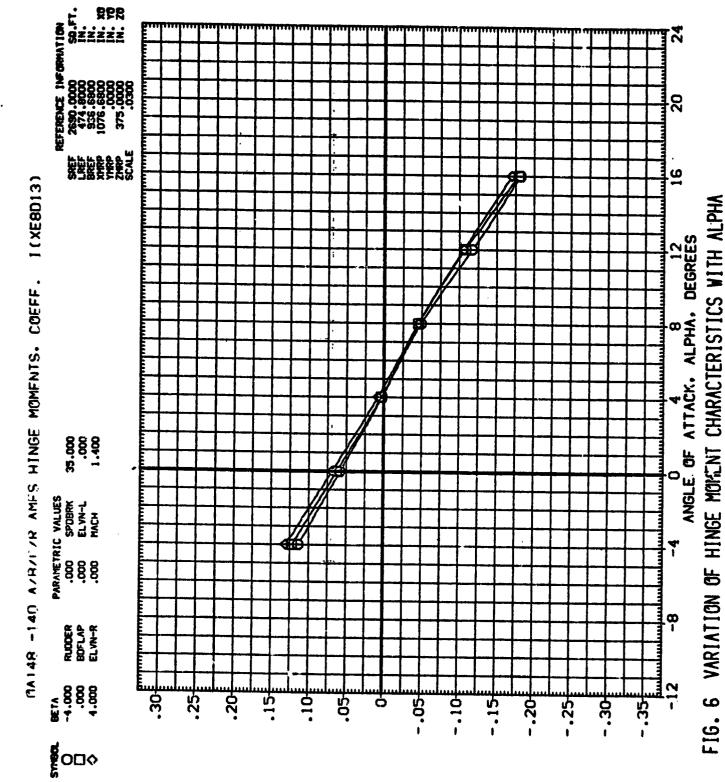
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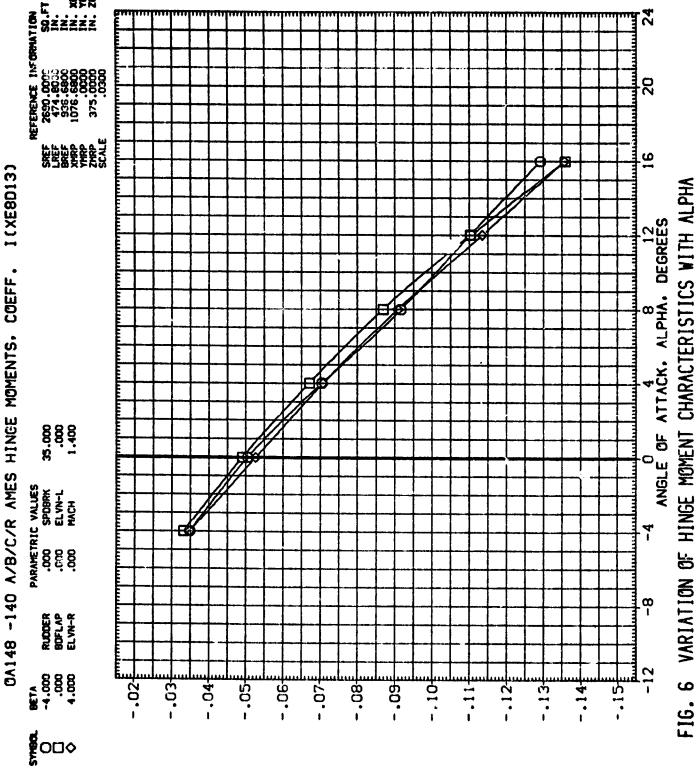
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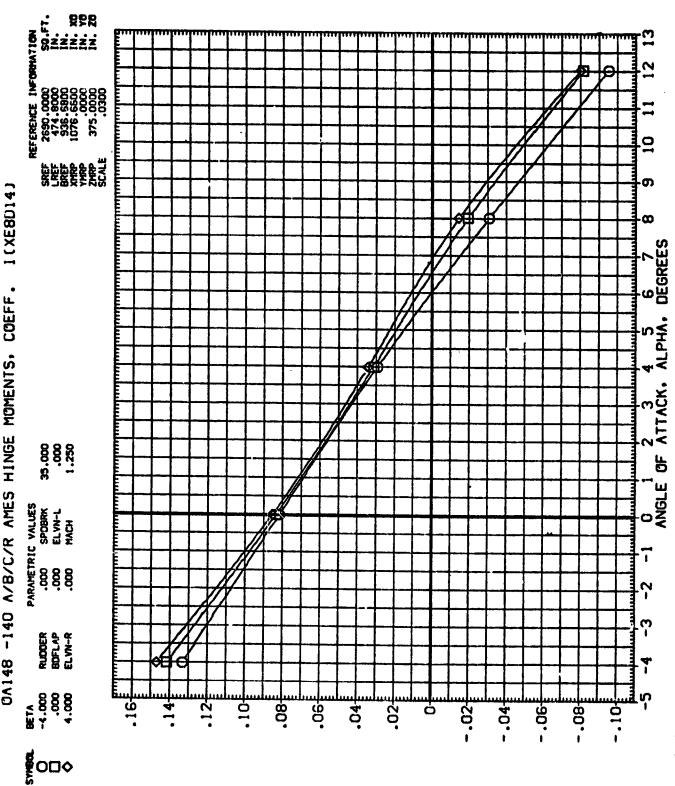


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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

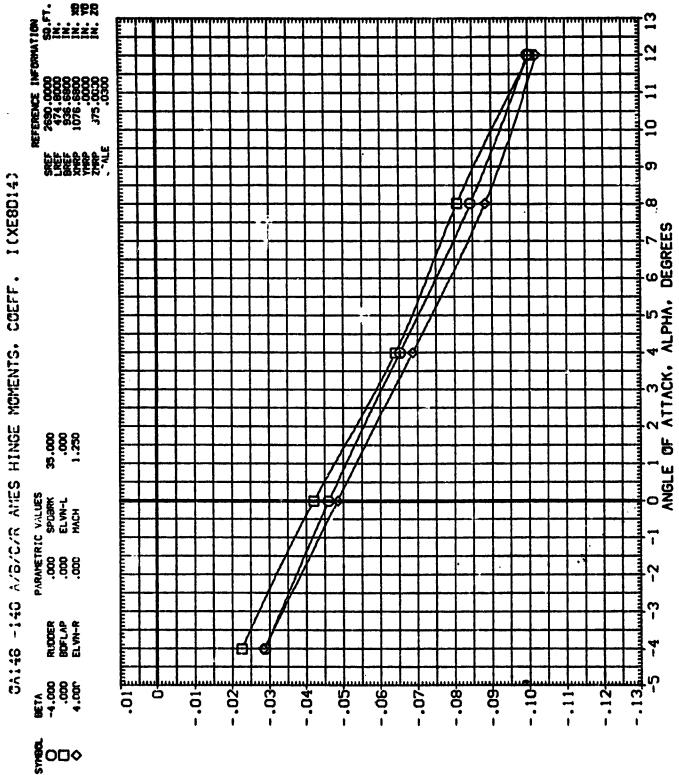


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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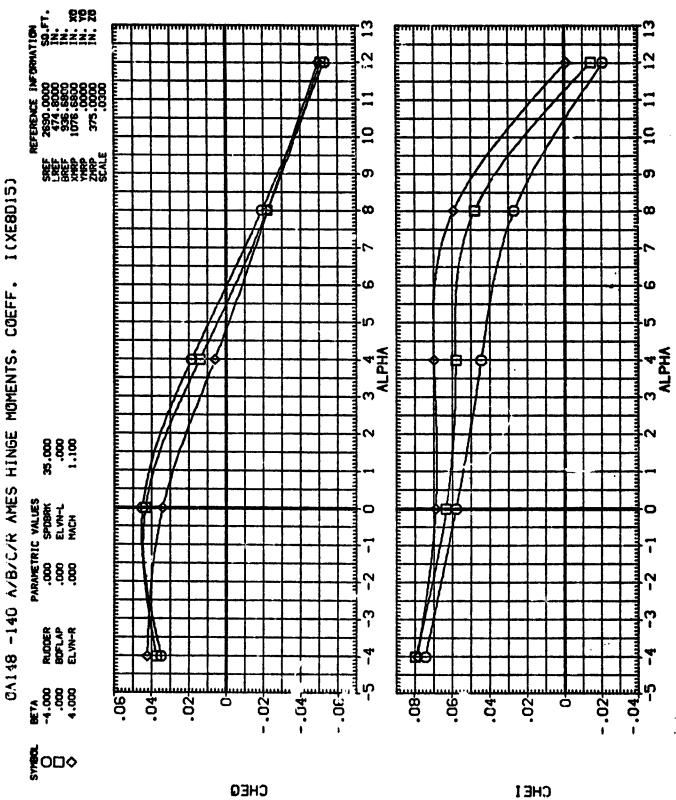
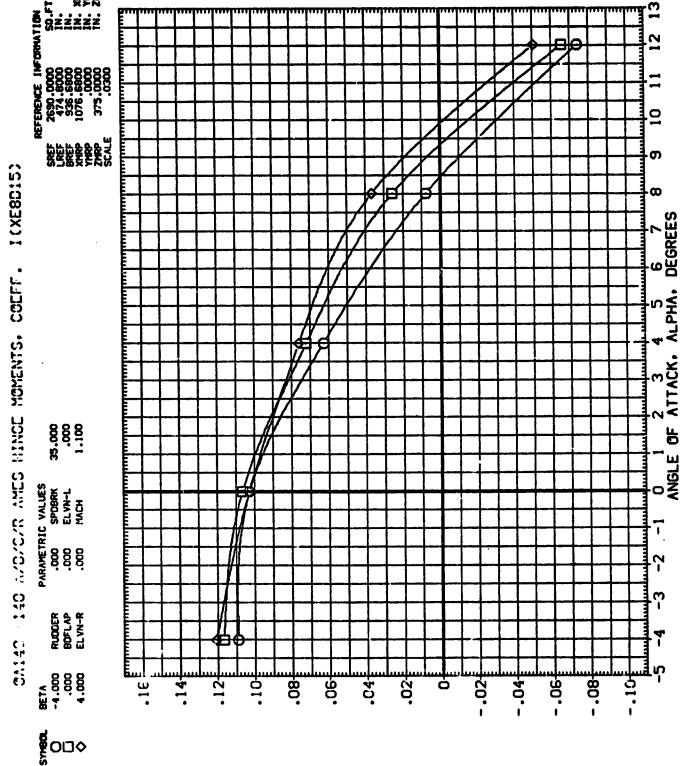


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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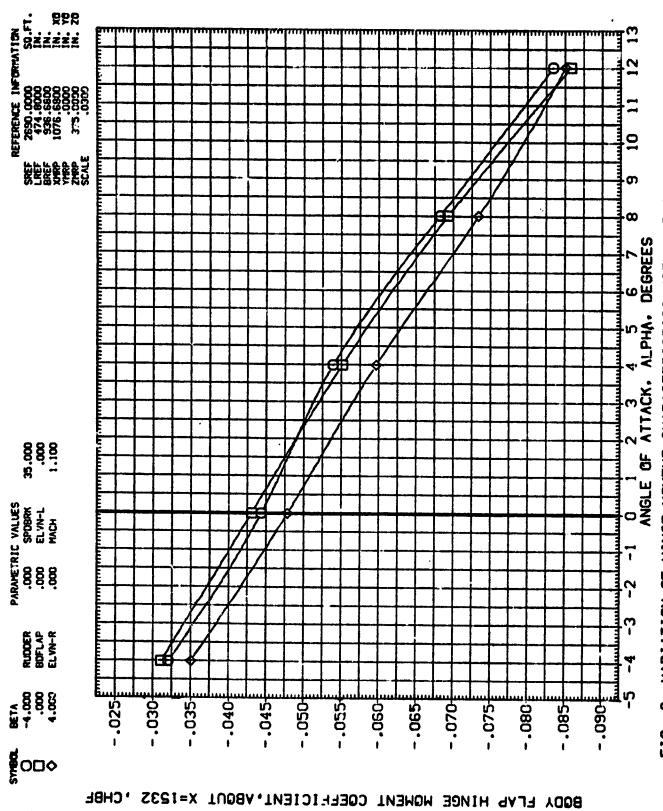


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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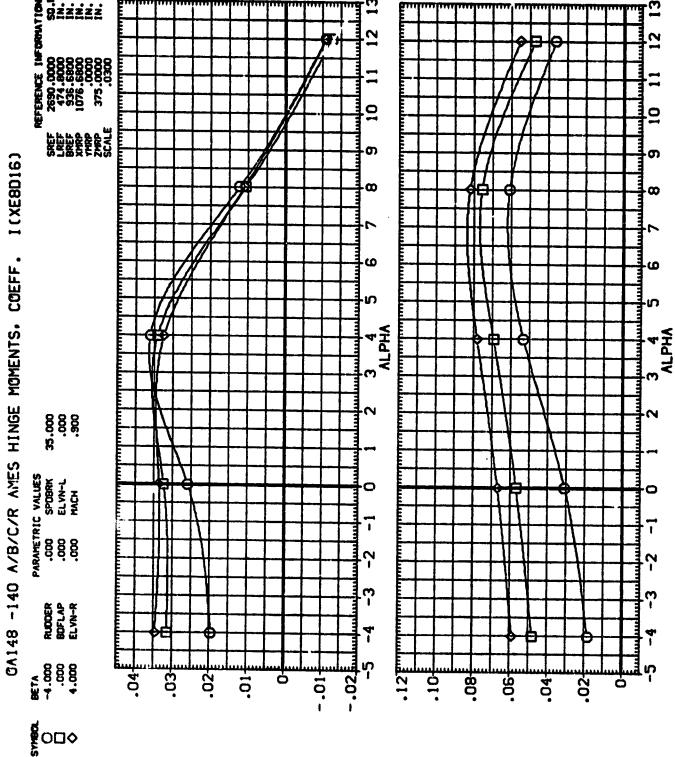
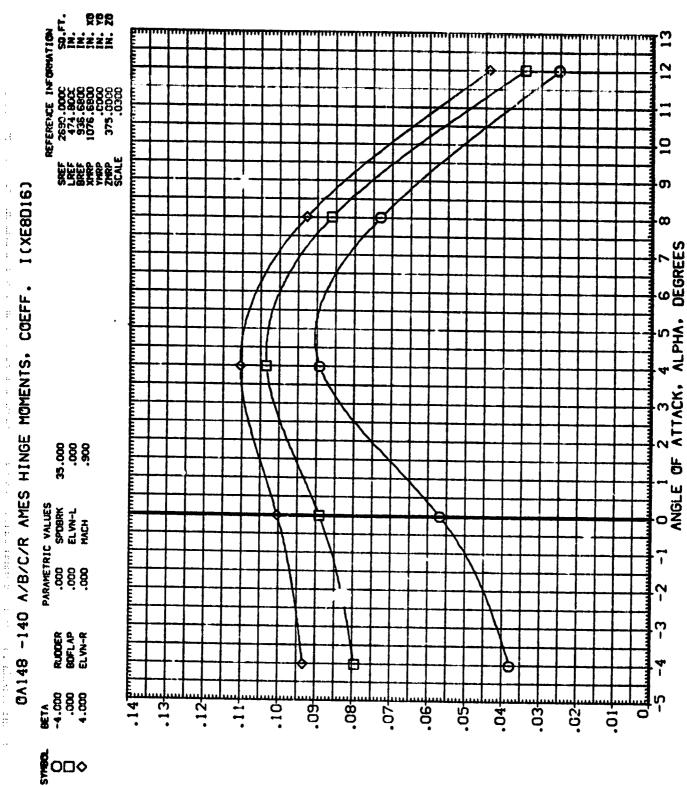


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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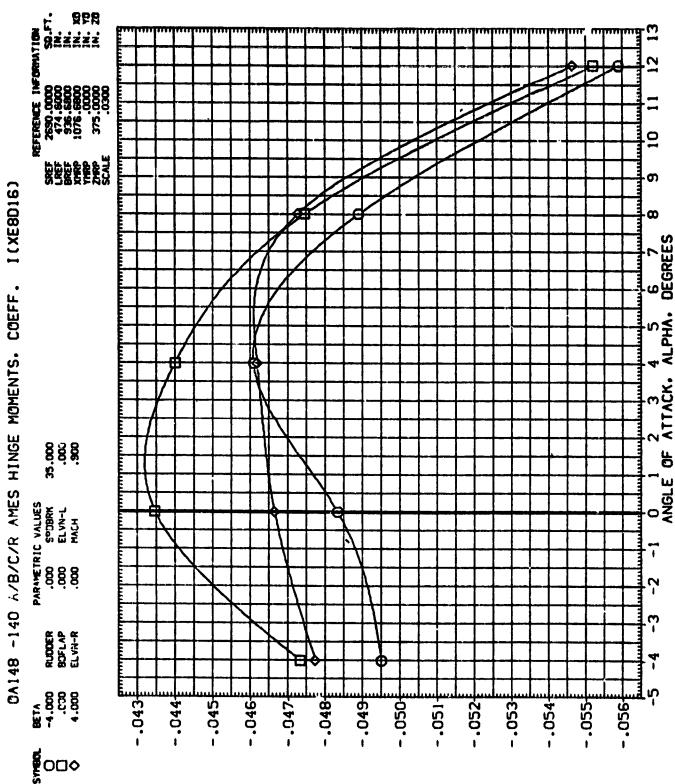


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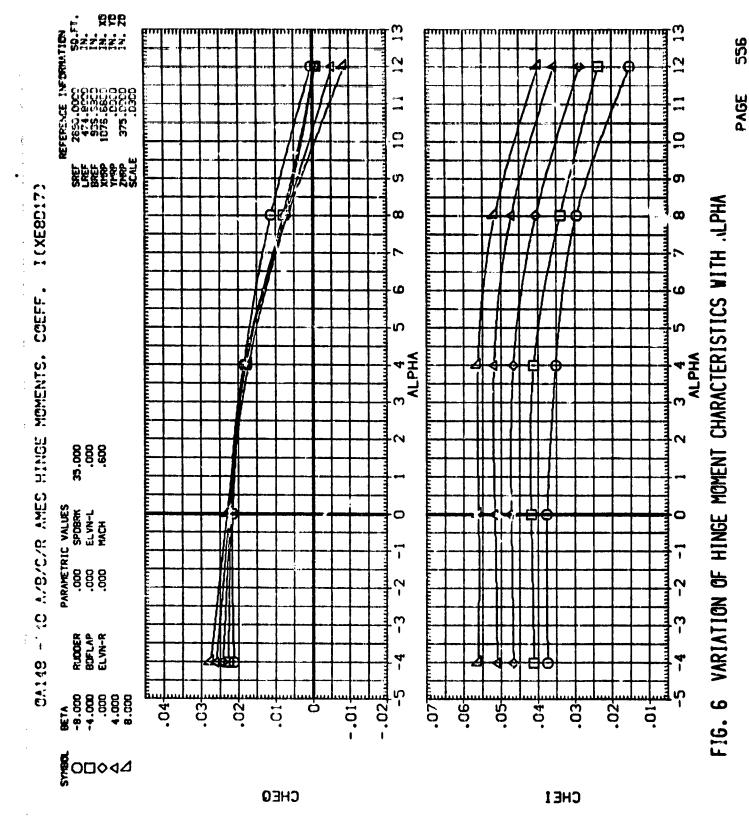
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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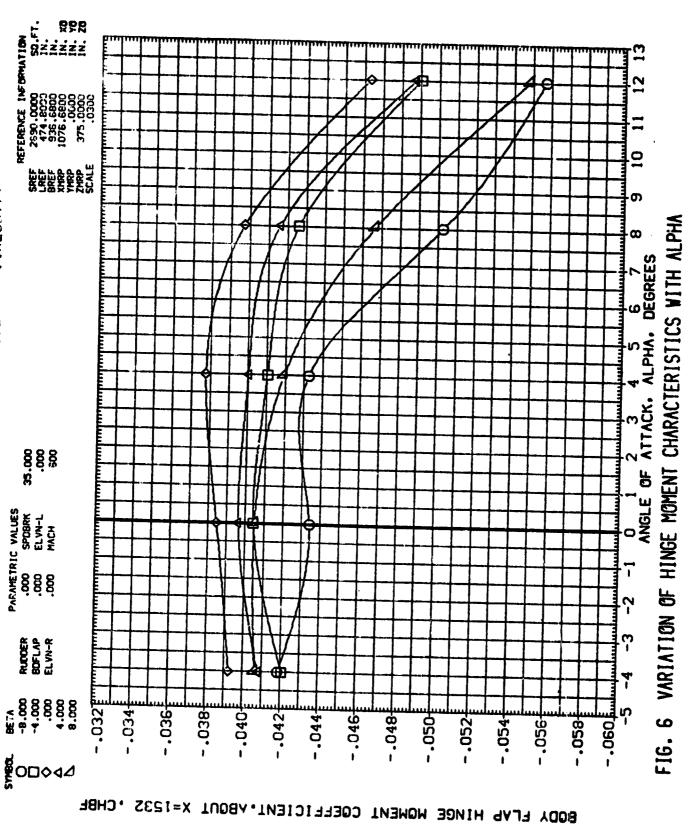


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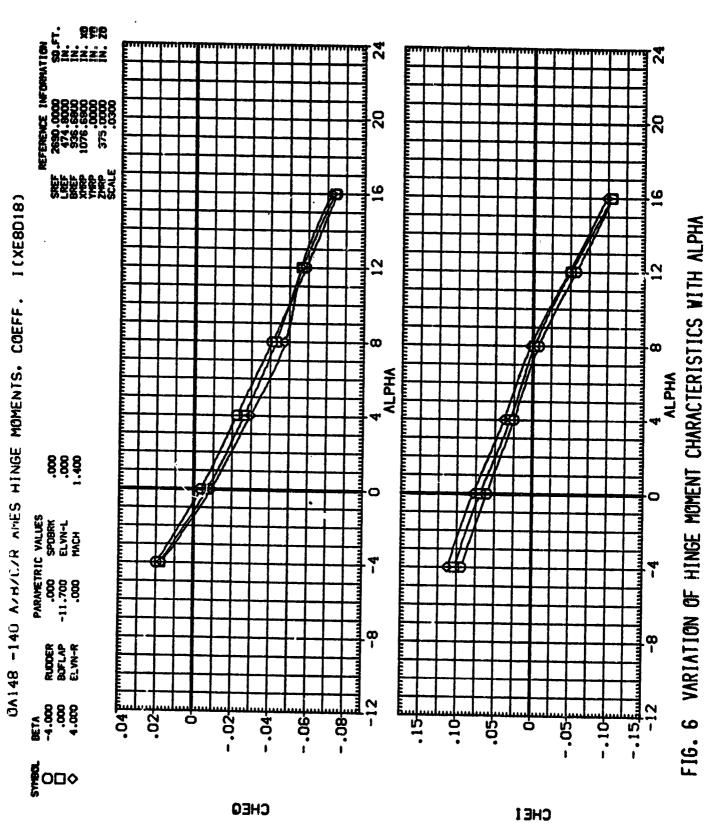
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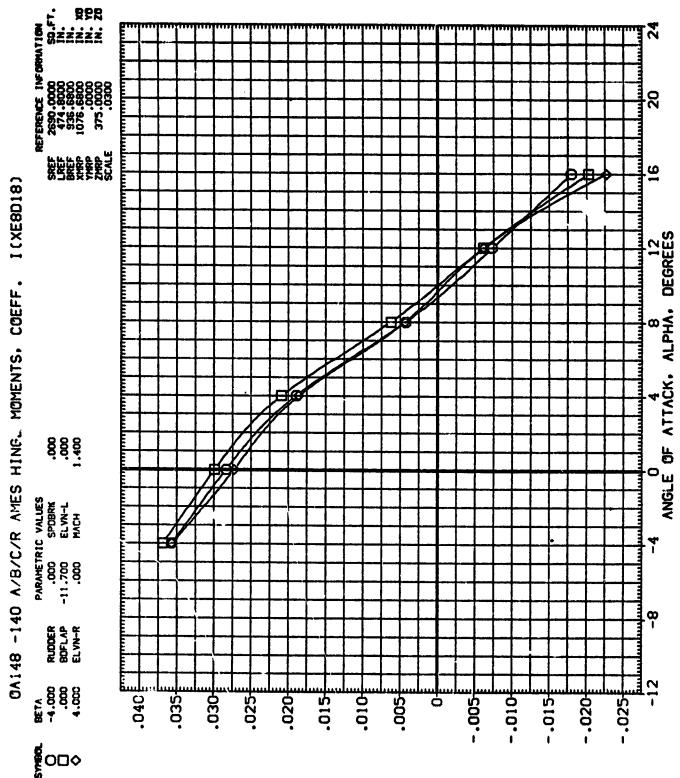






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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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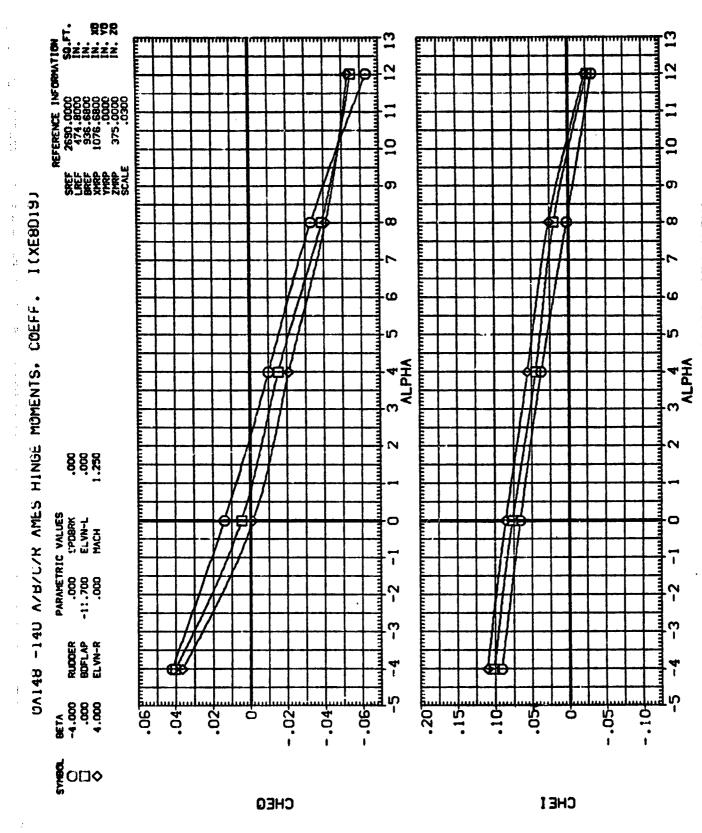


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

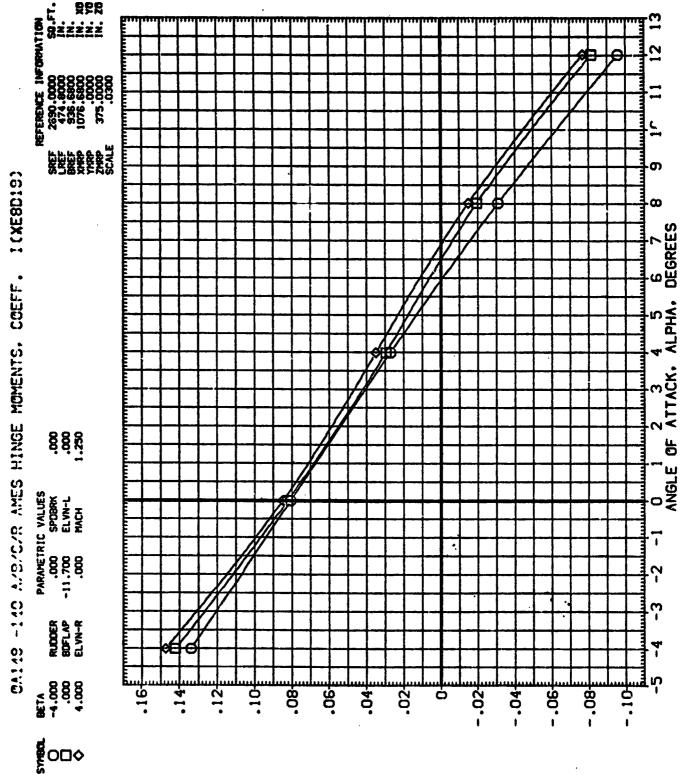
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VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA FIG. 6

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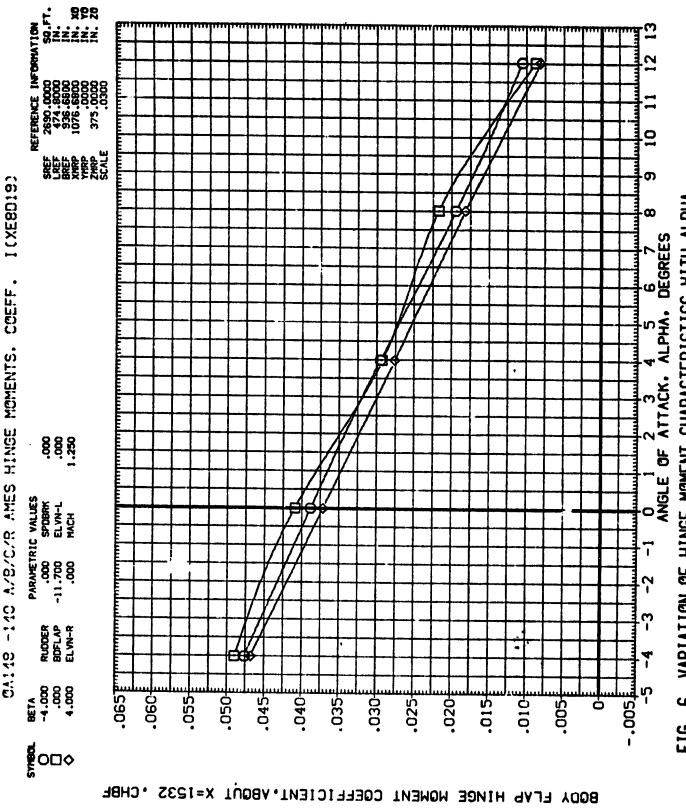


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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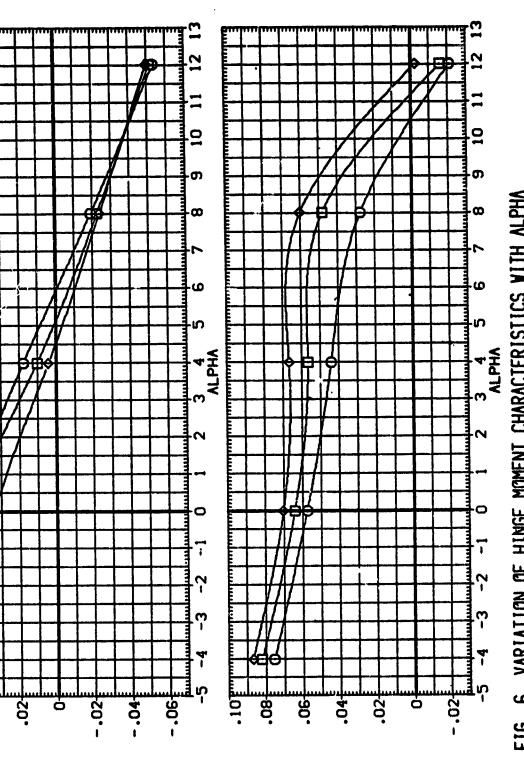
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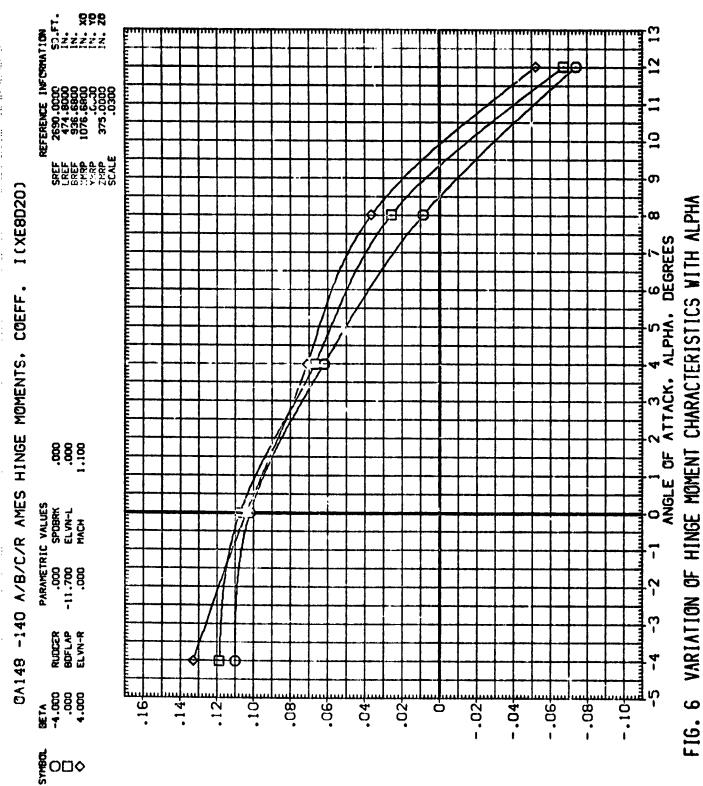
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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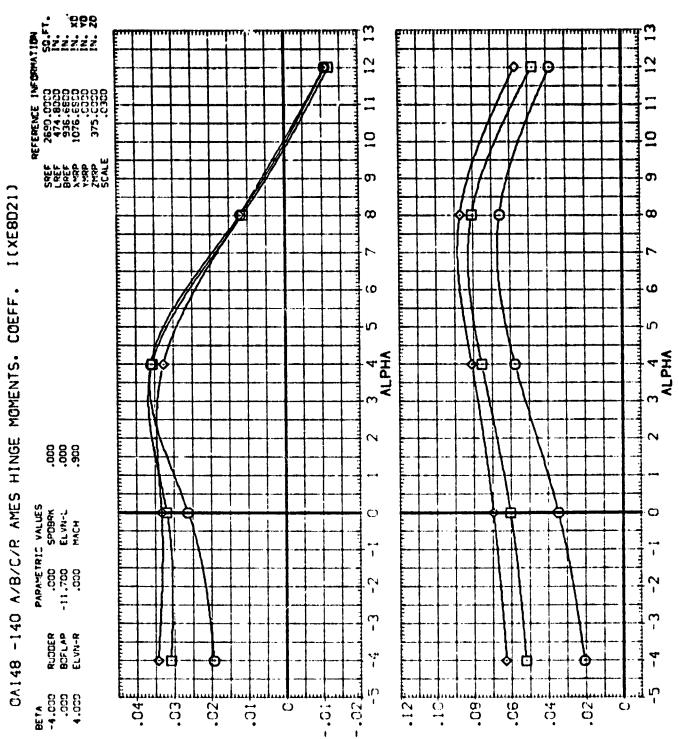
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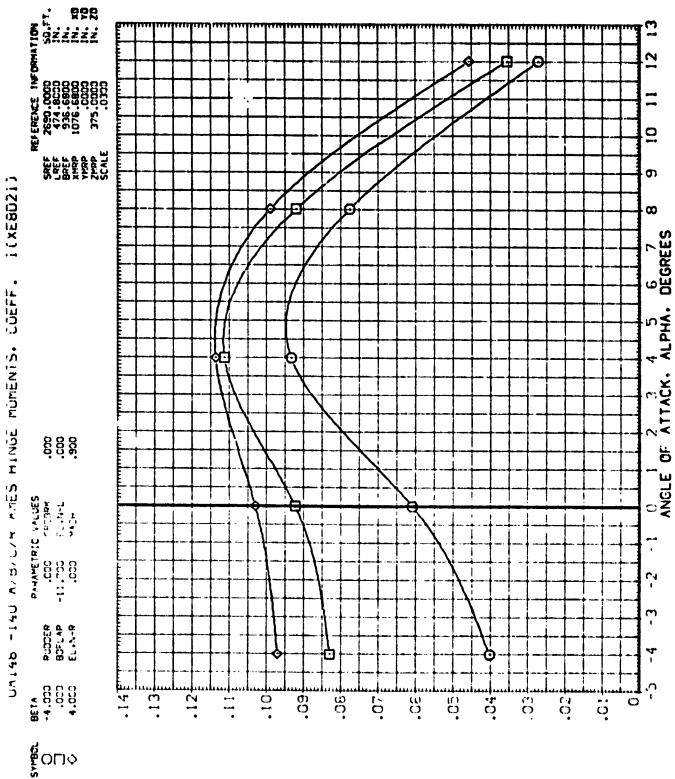
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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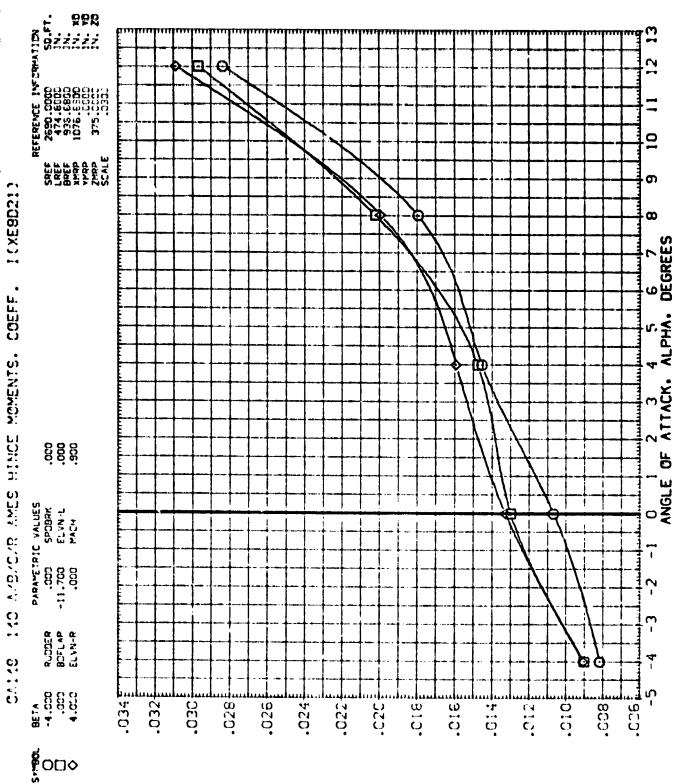
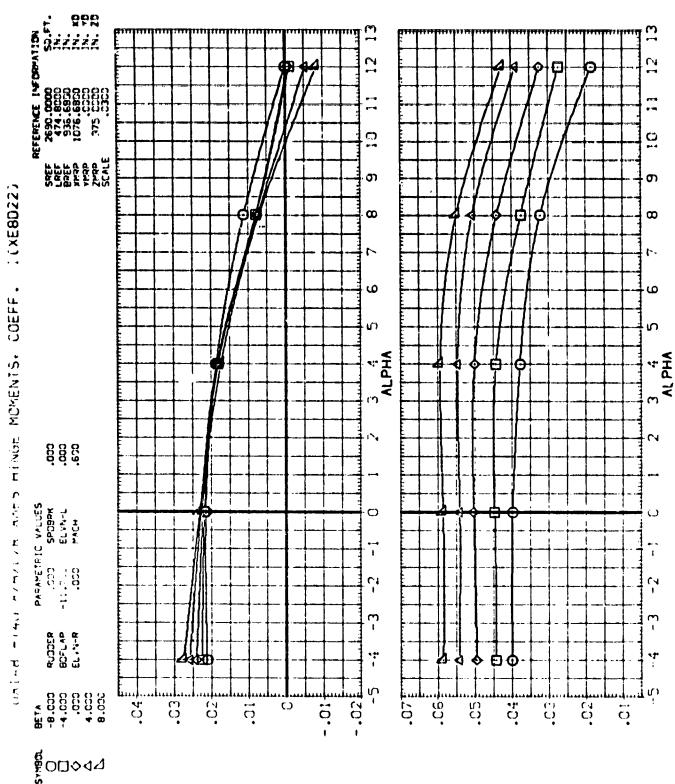


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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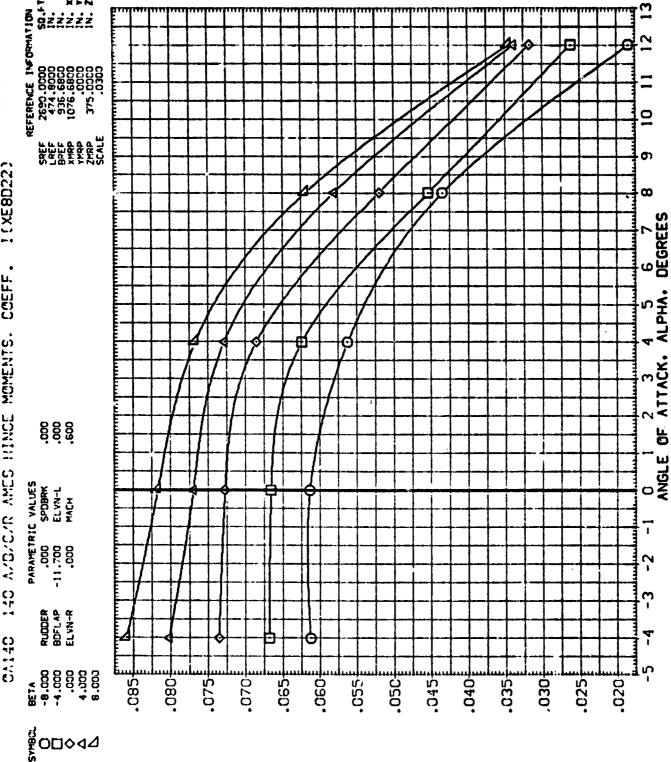
VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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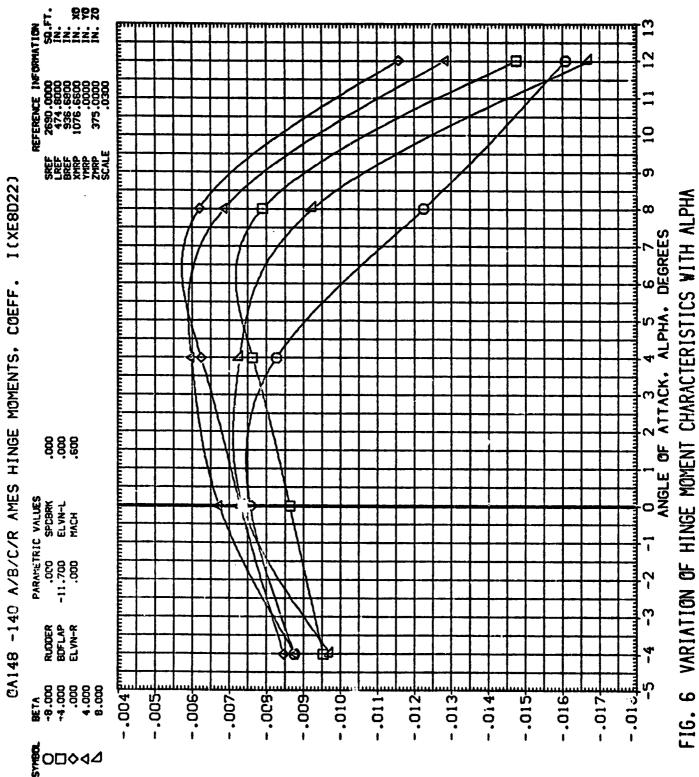
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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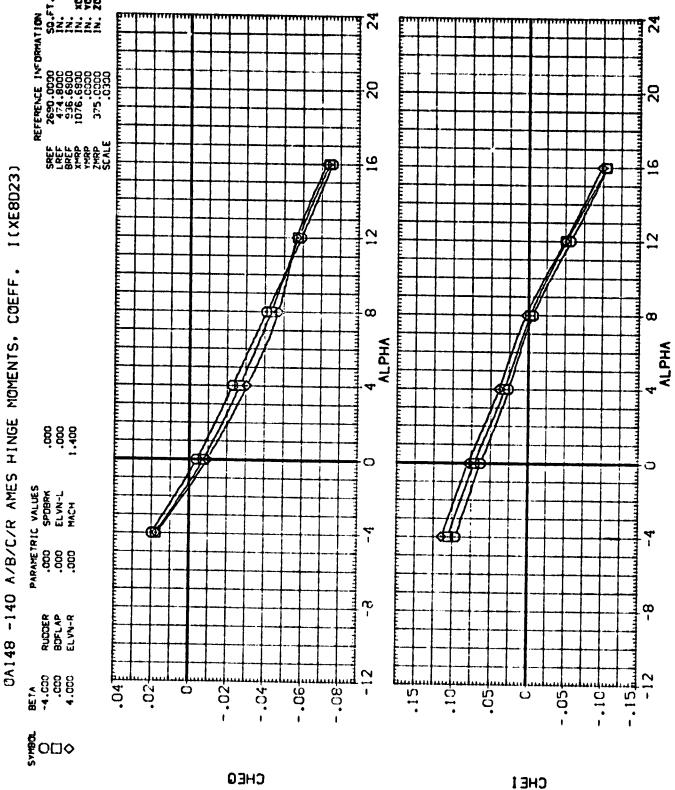
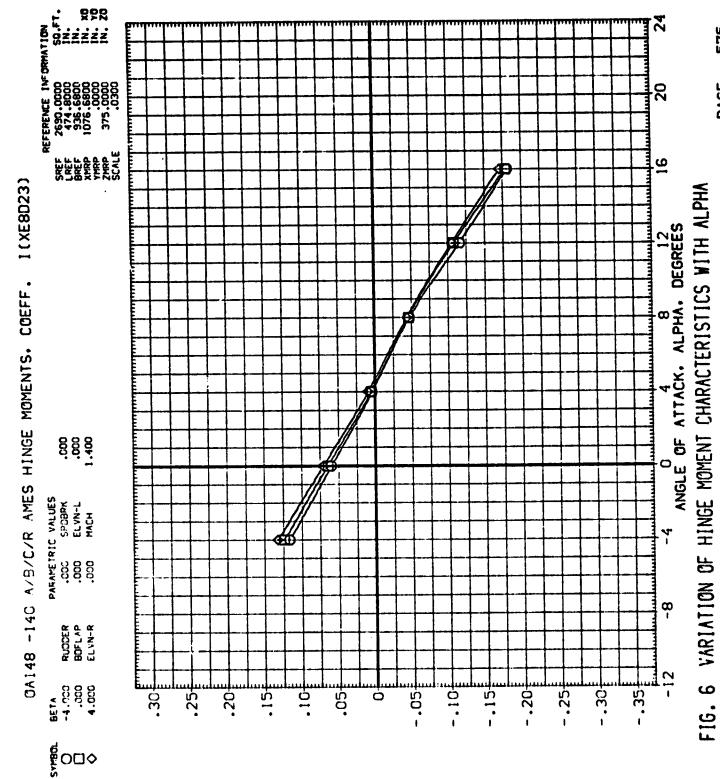


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA ANGLE OF ATTACK, ALPHA, DEGREES

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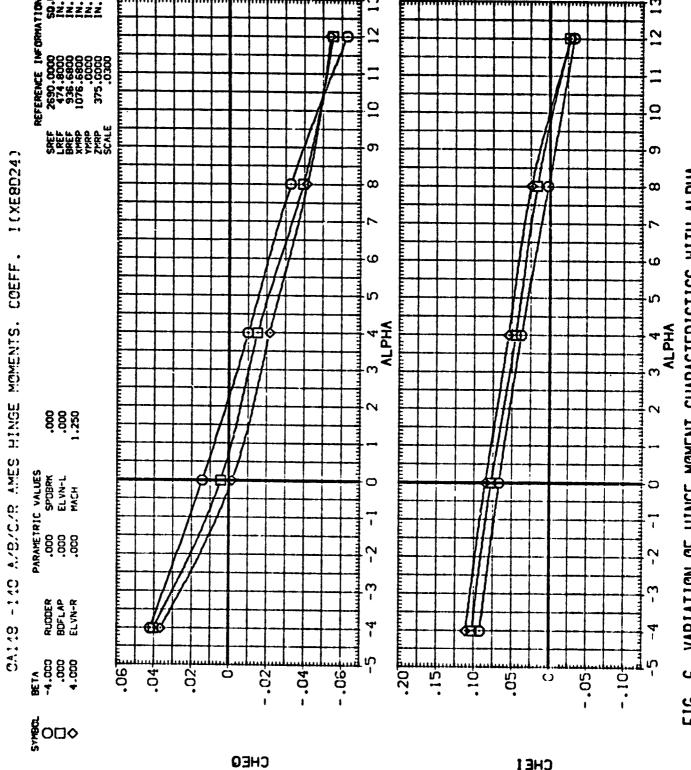
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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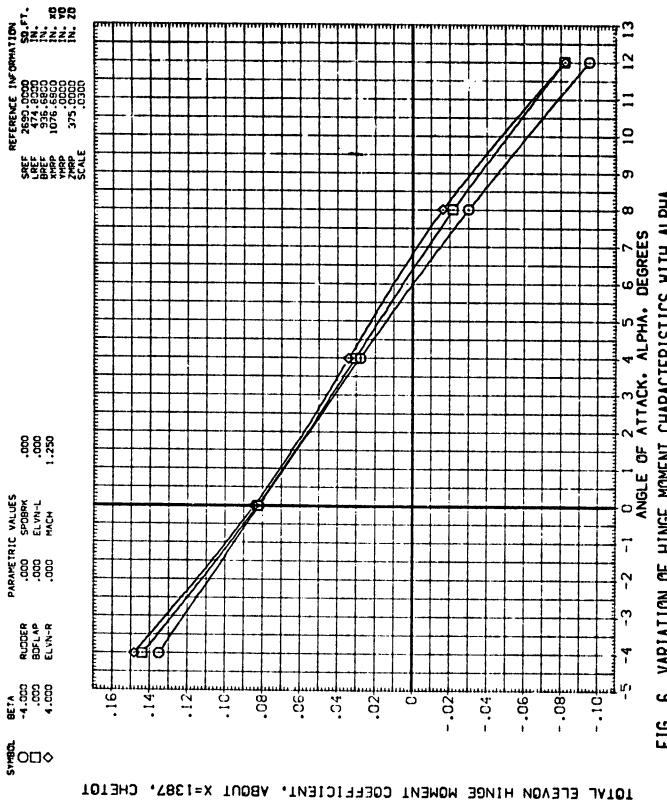


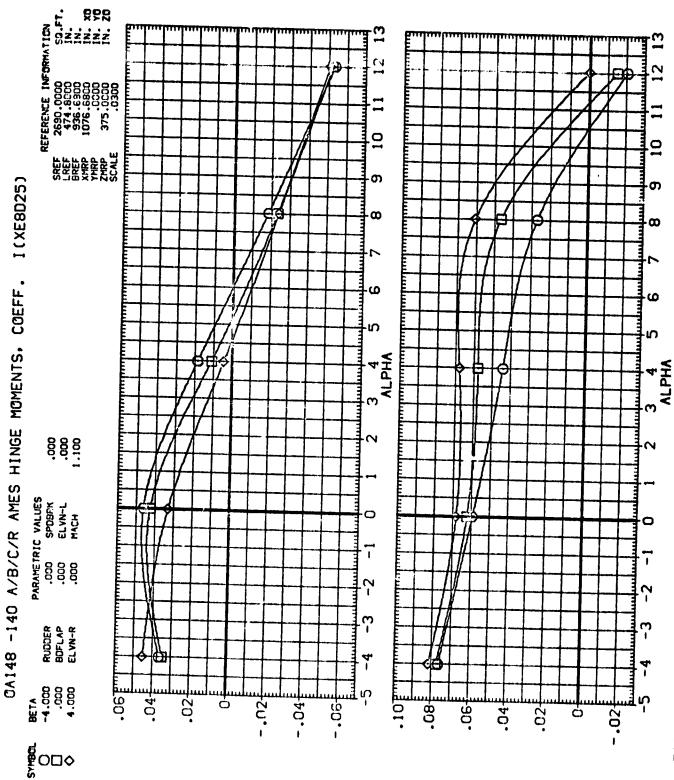
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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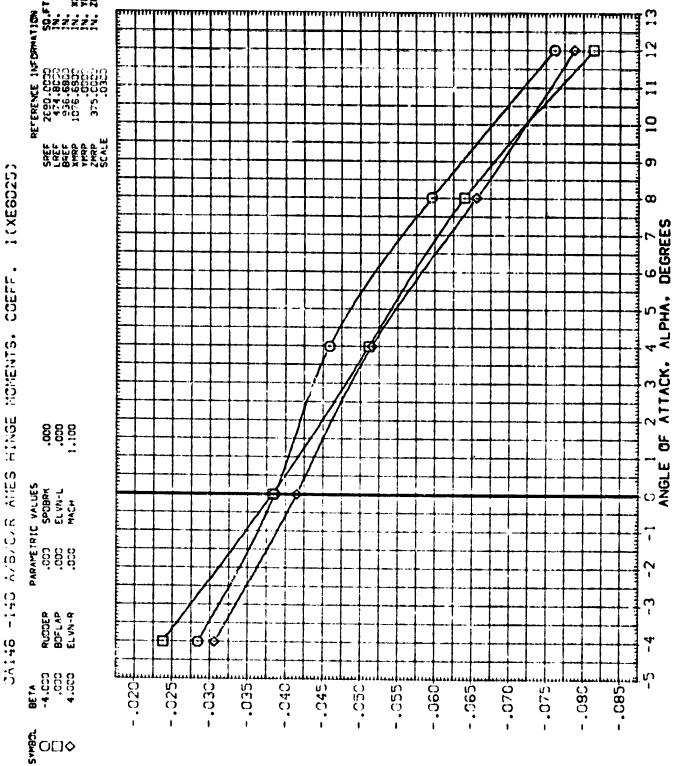
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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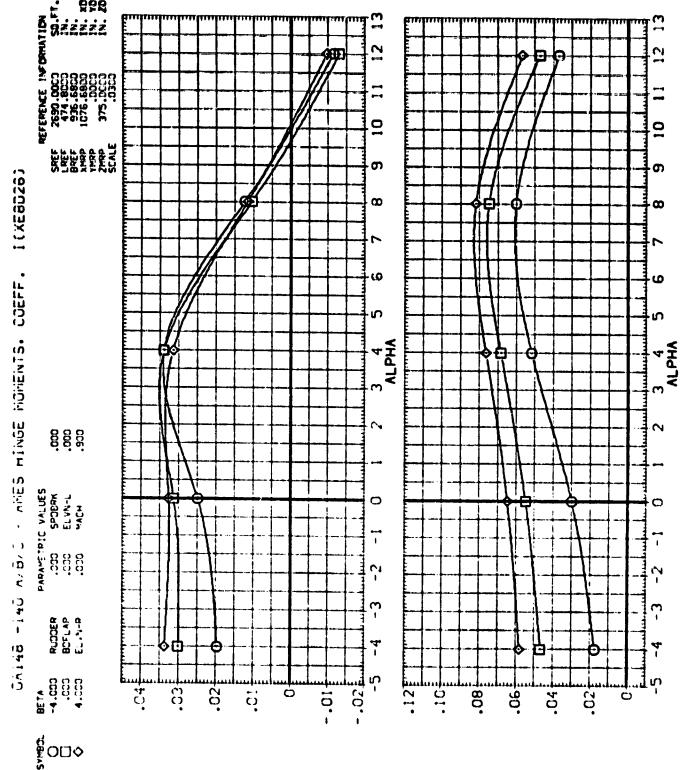
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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

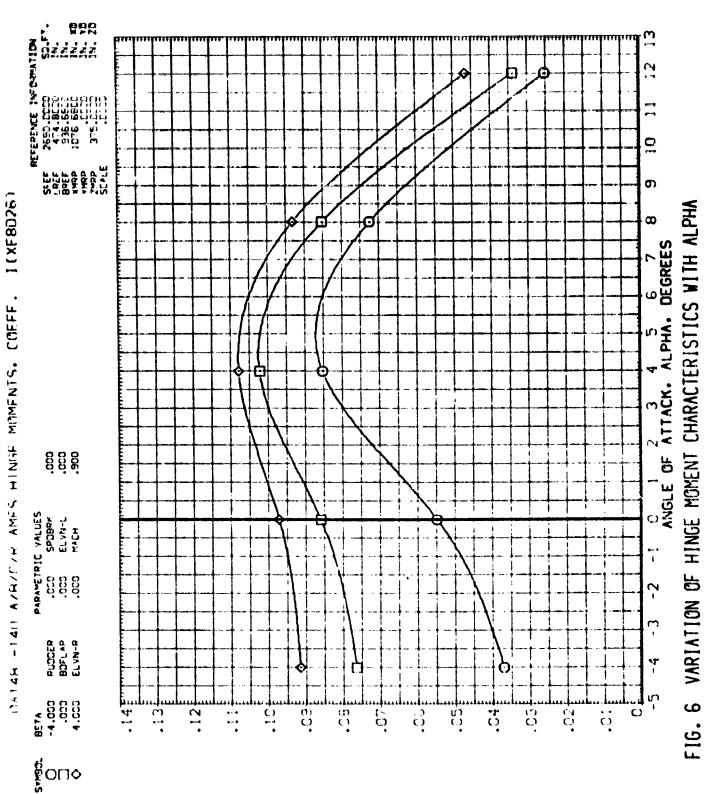


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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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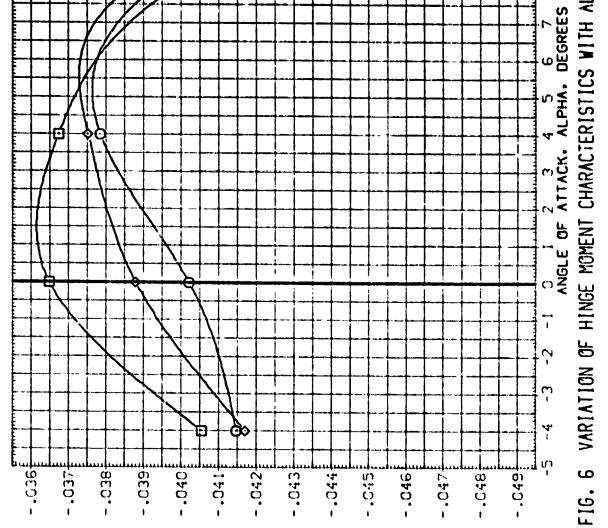
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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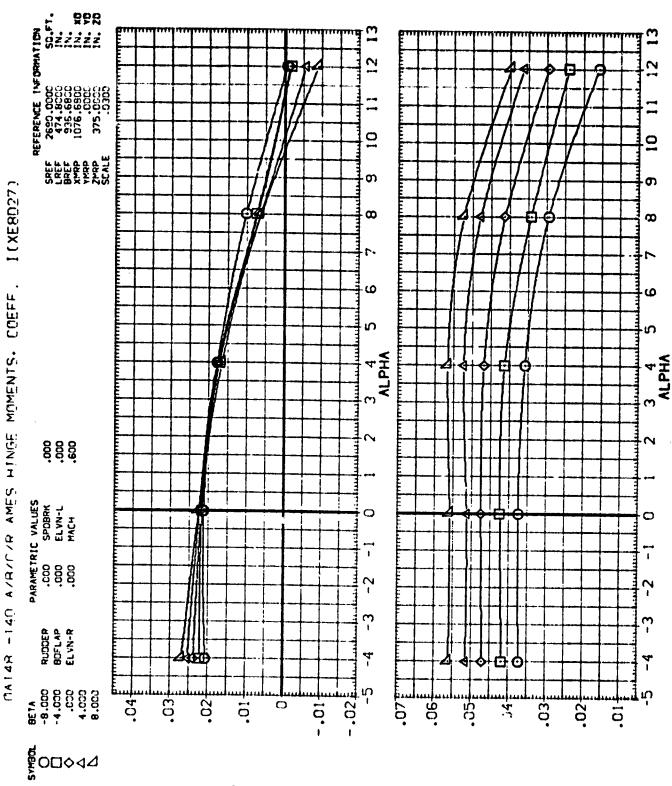
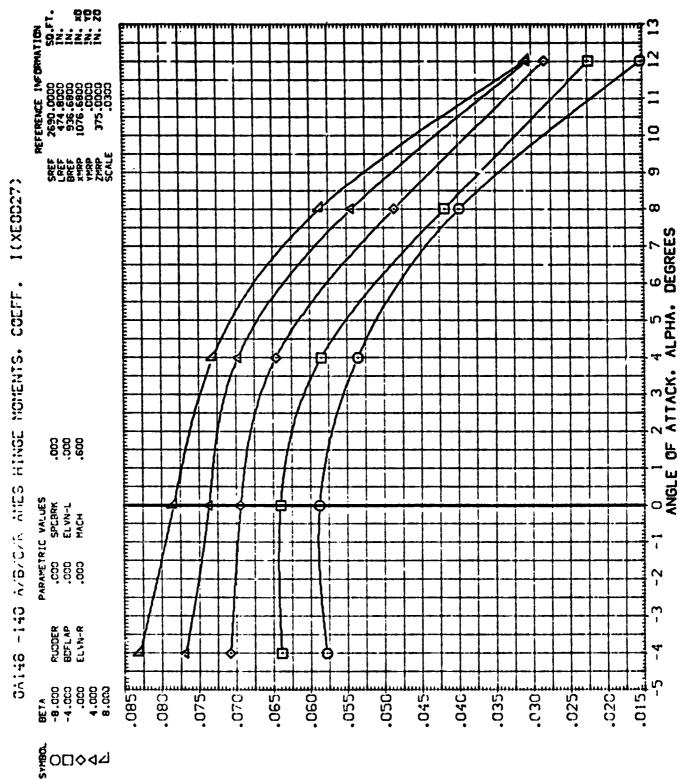


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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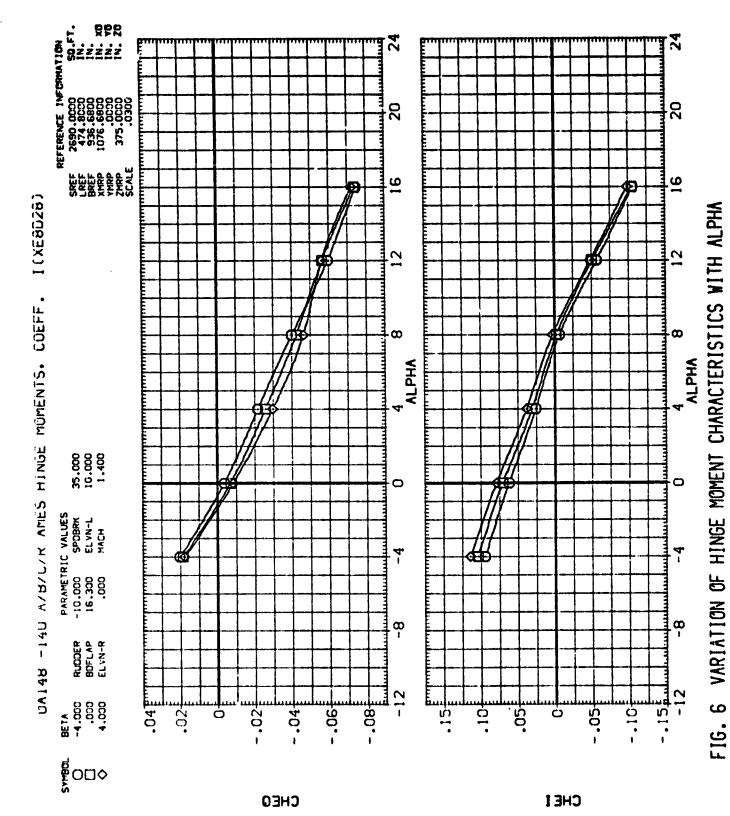
BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 . CHBF

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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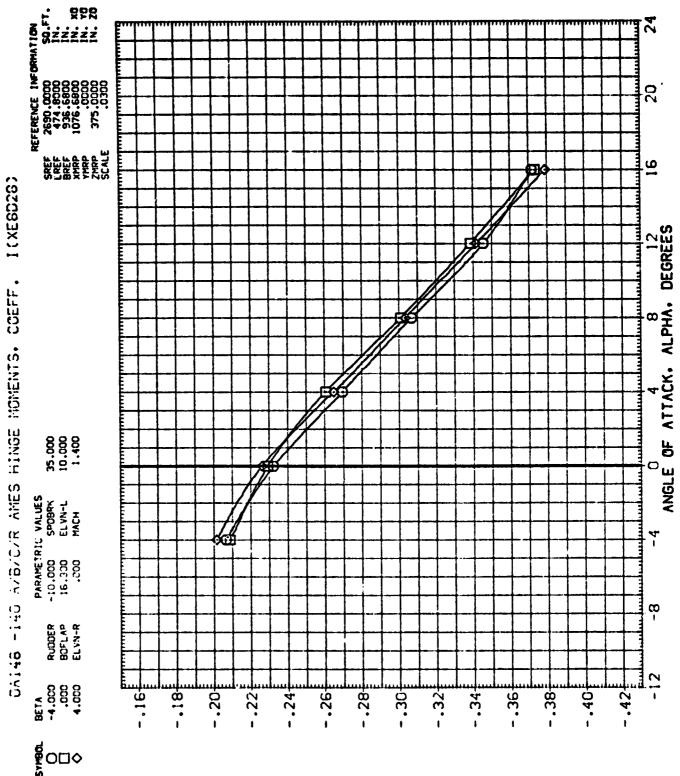
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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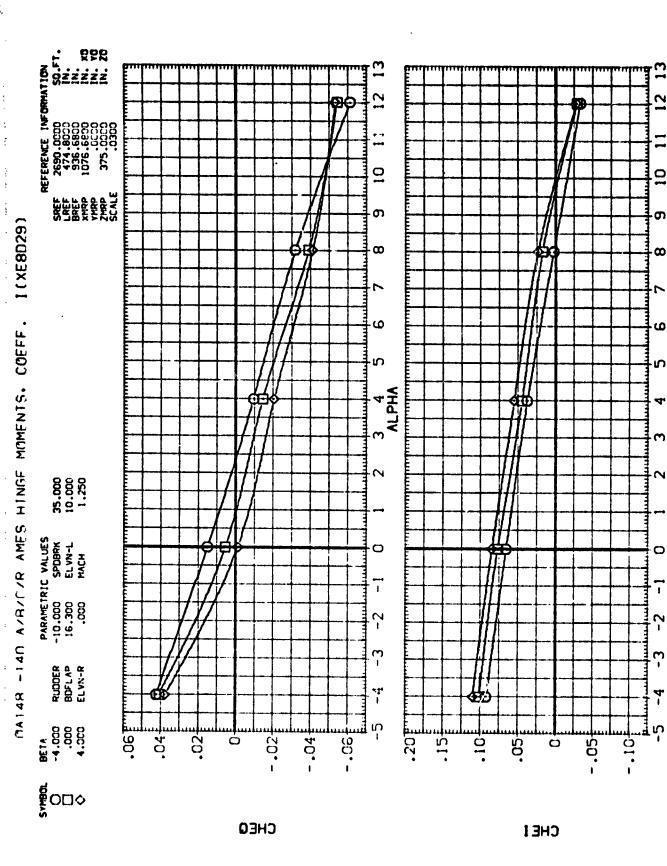
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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA FIG. 6

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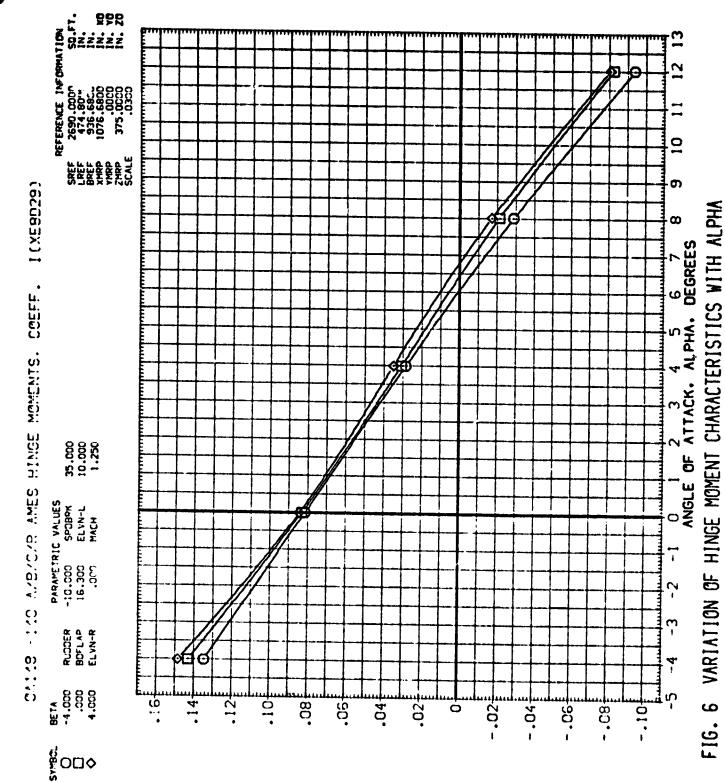
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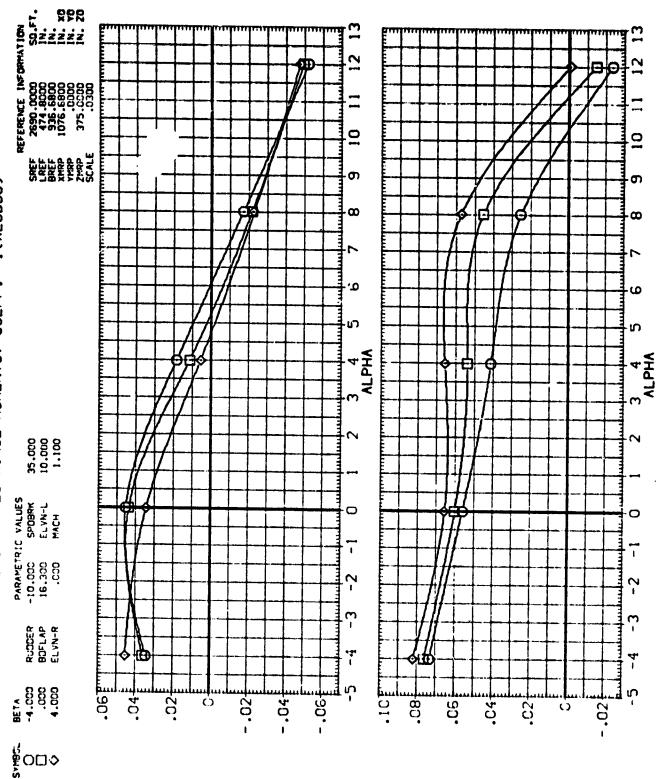
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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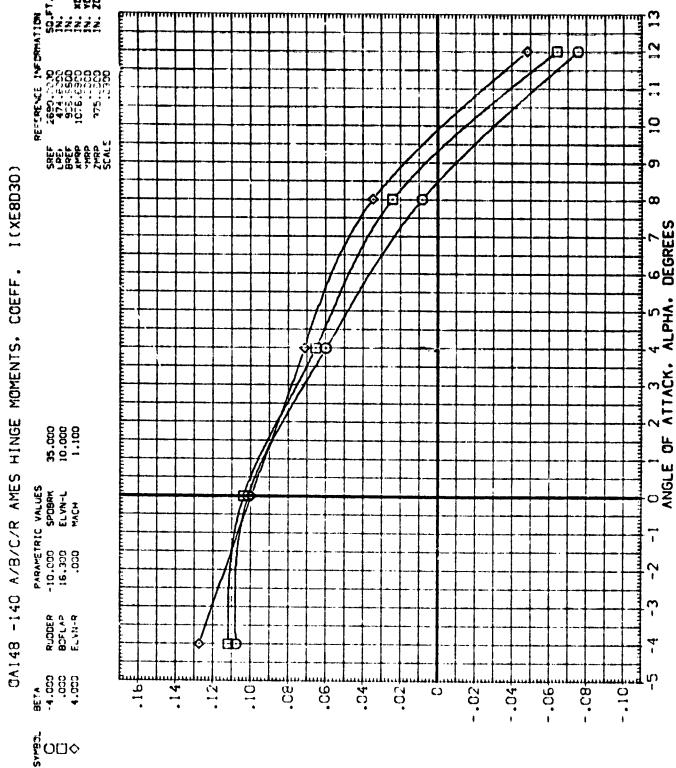


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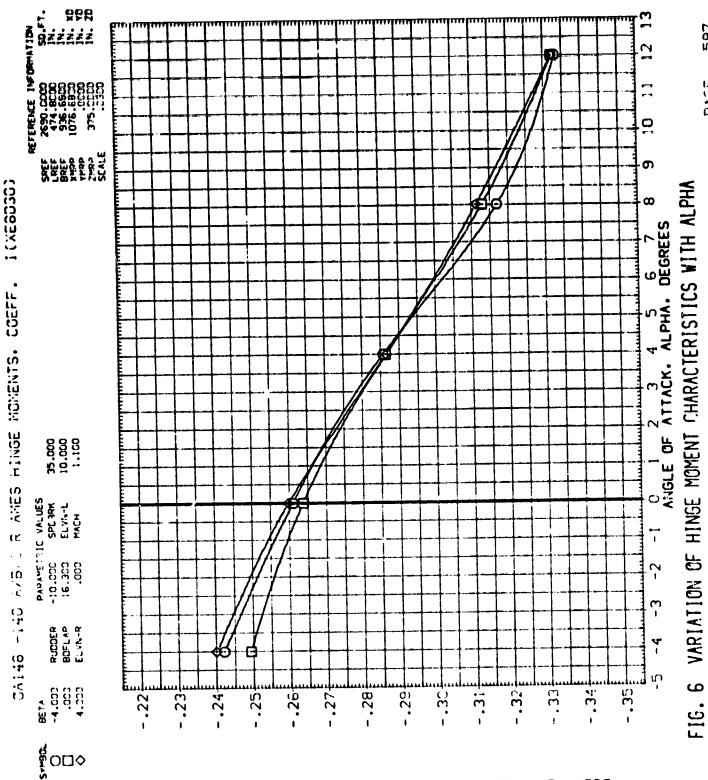
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



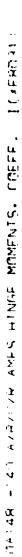
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT



BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

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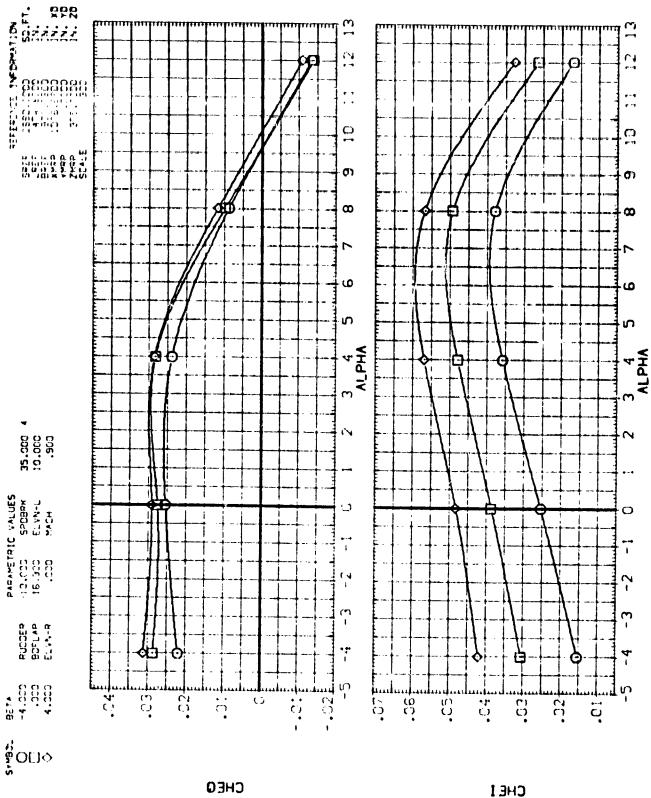
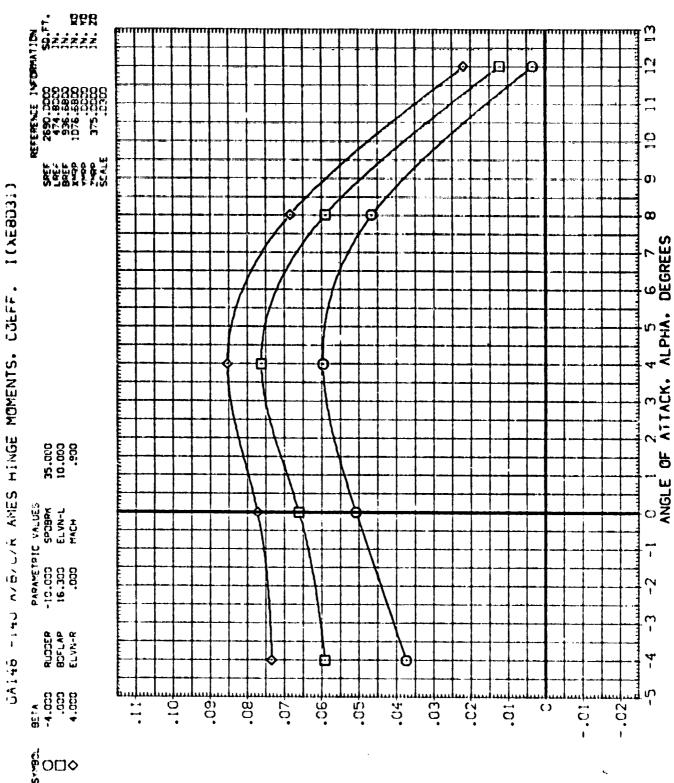


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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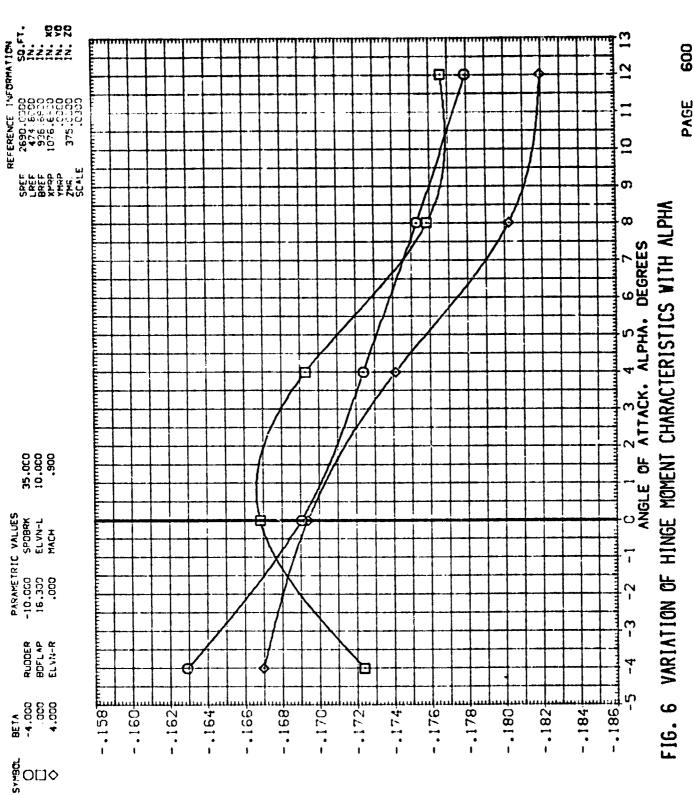


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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

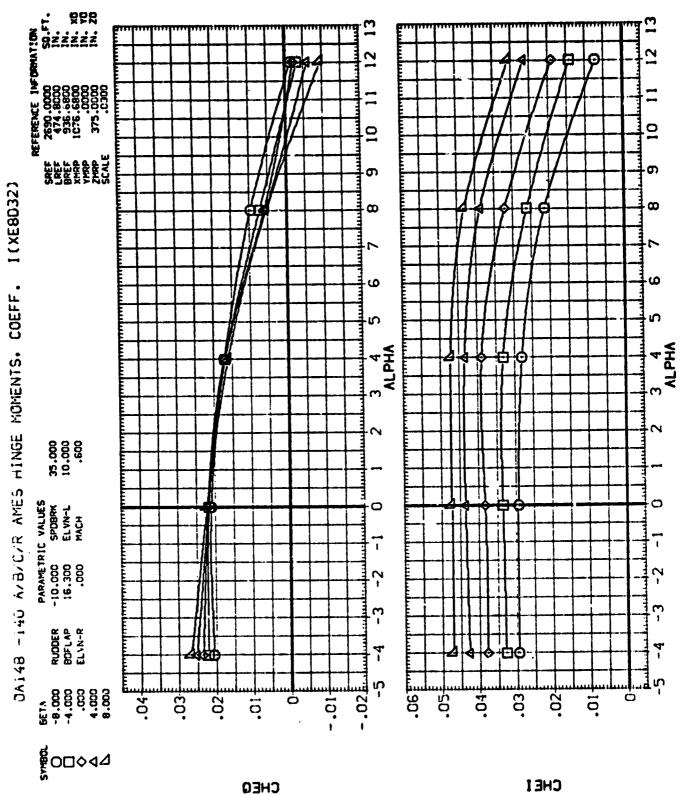
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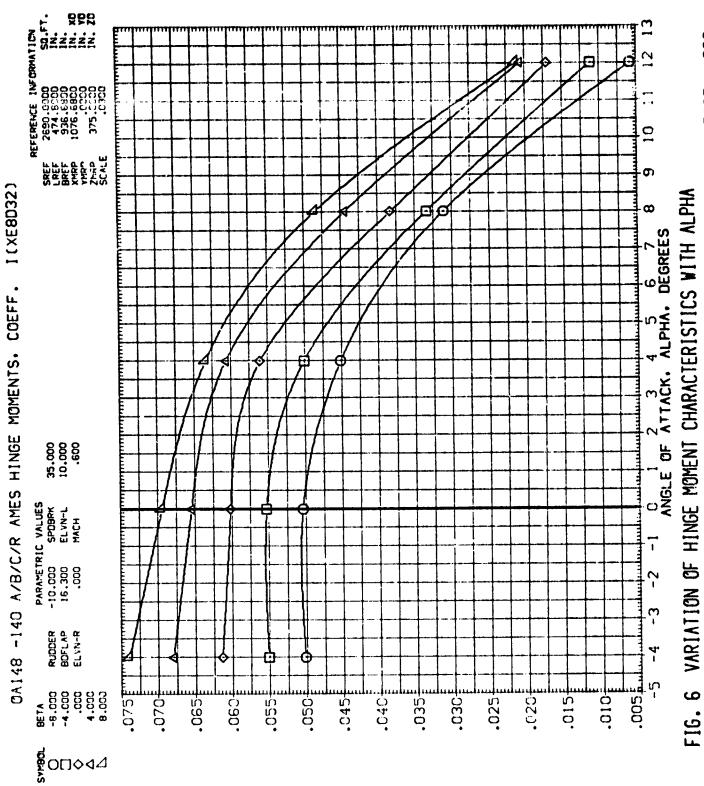


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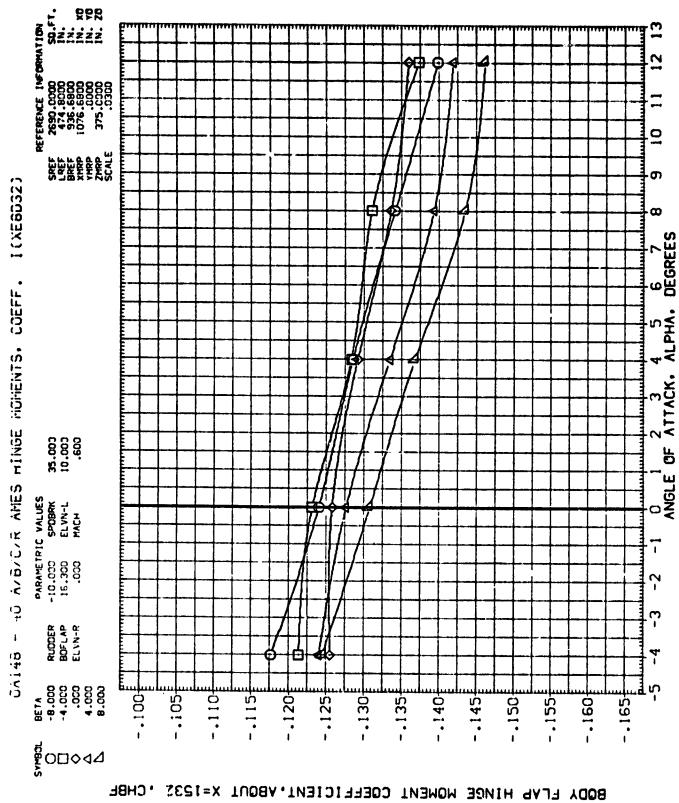
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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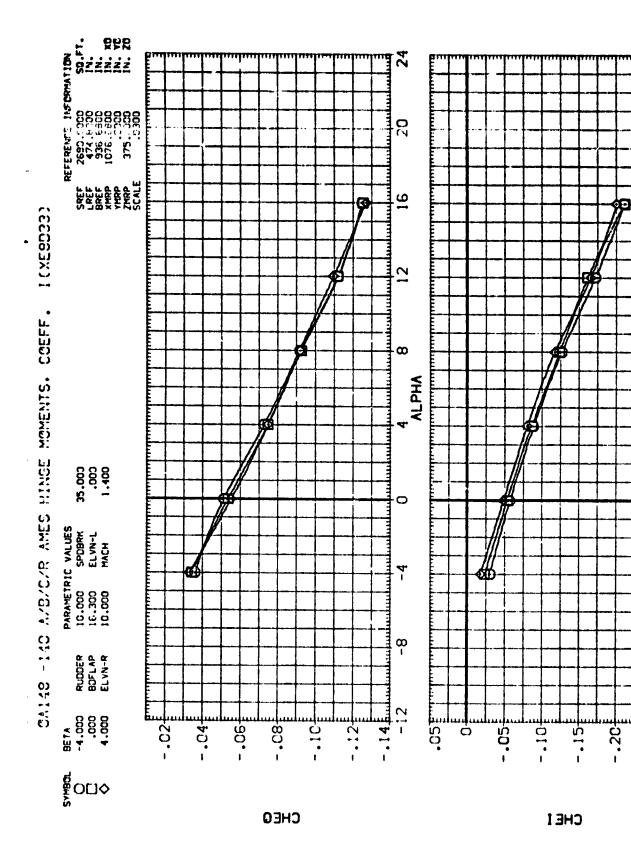


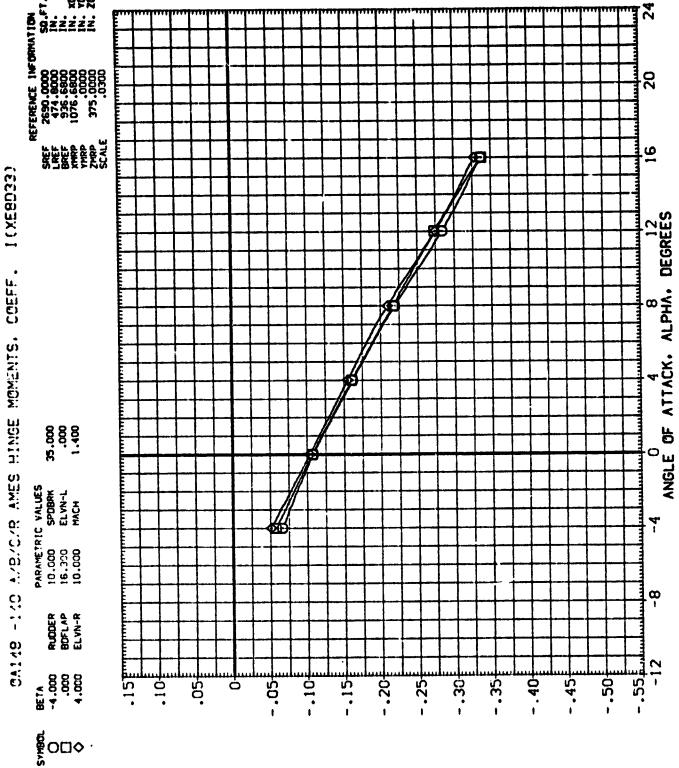
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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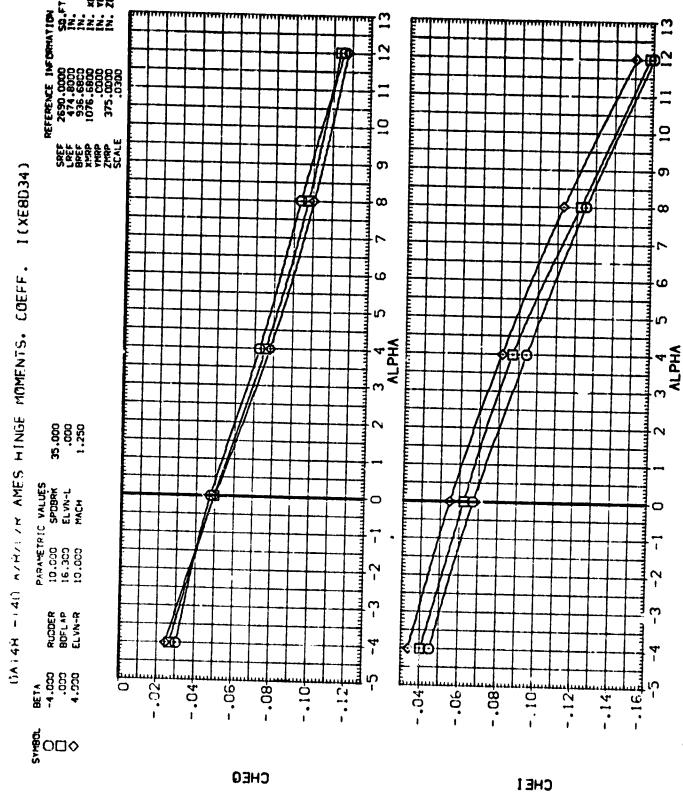
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1 (XE8D33)

50 9 FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA ANGLE OF ATTACK, ALPHA, DEGREES

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

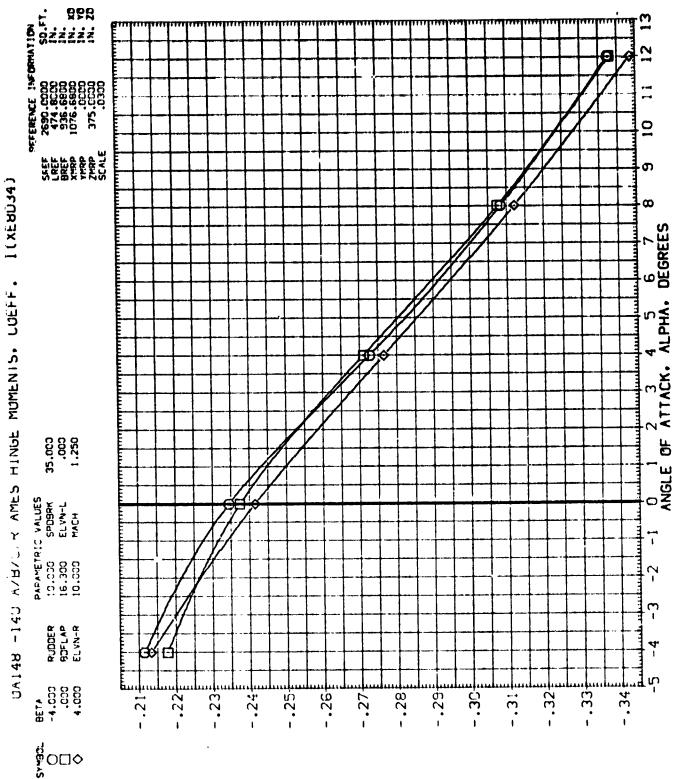
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF



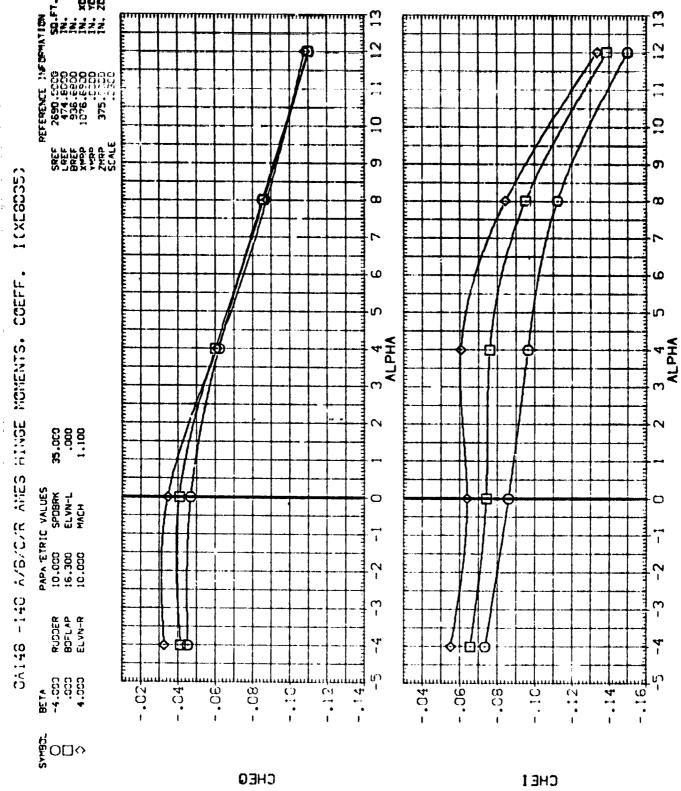
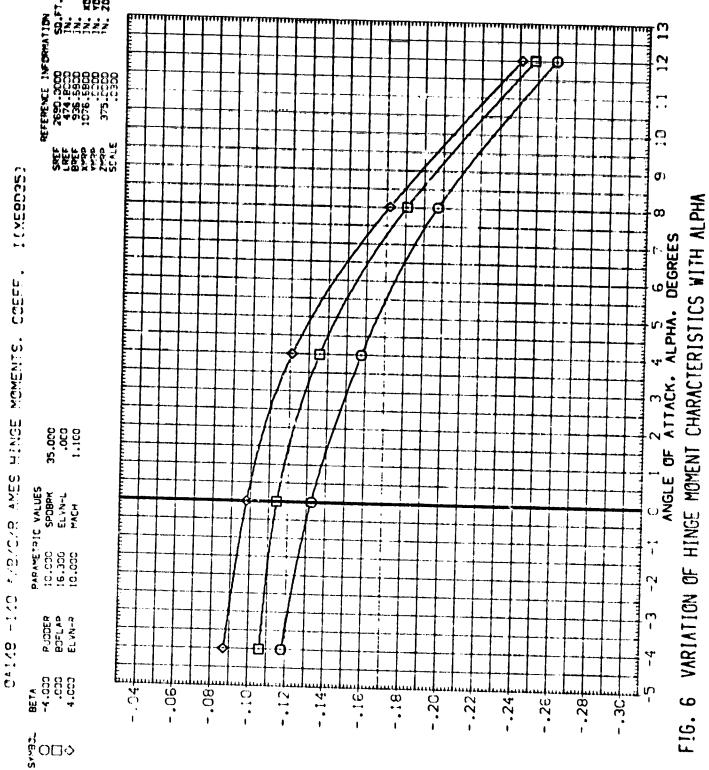


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA ATTACK, ALPHA, DEGREES O 1 2

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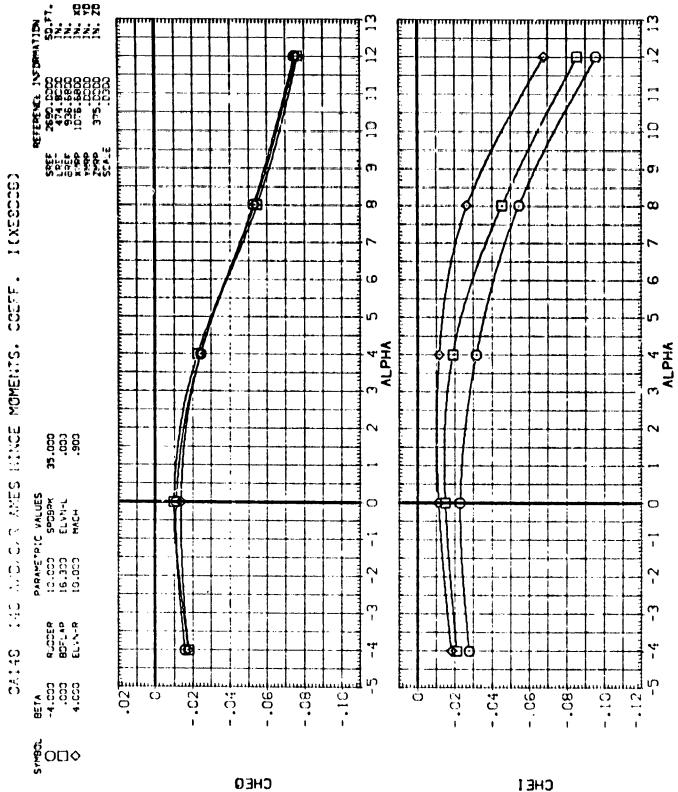
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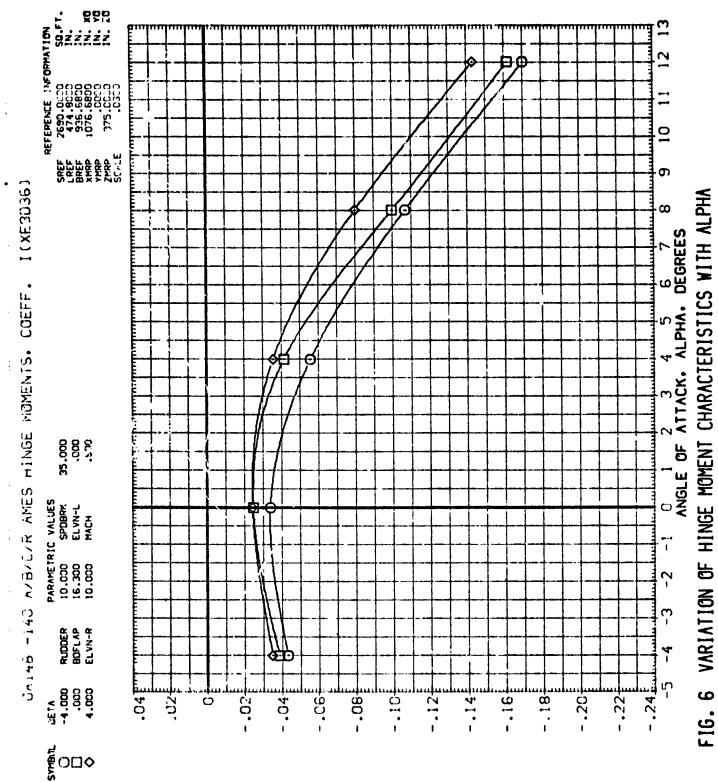
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VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

FIG. 6





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TOTAL ELEVON HINGE MOMENT COEFFICIENT, AROUT X=1387, CHETOT

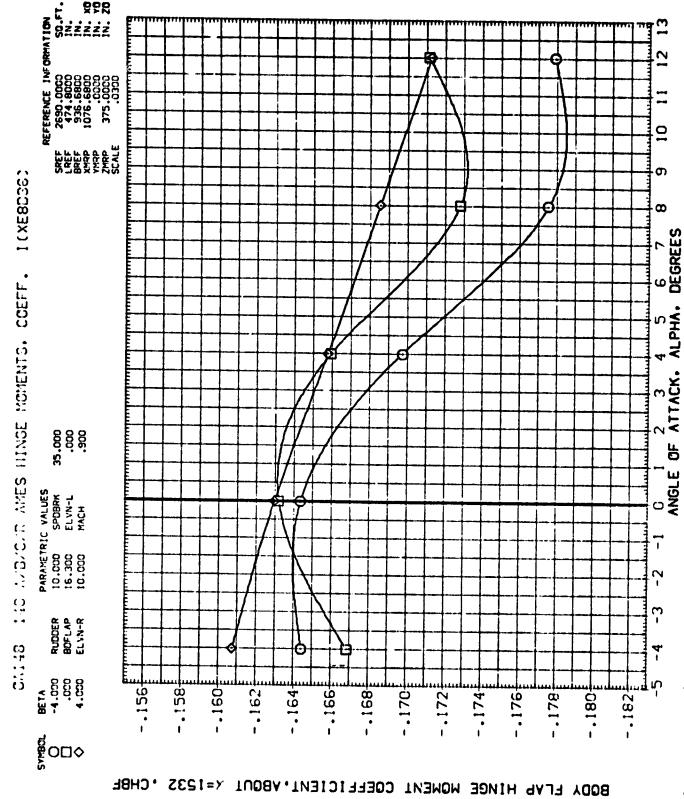


FIG. 6 VARIATION OF HINGE MOMENT CHARASTERISTICS WITH ALPHA

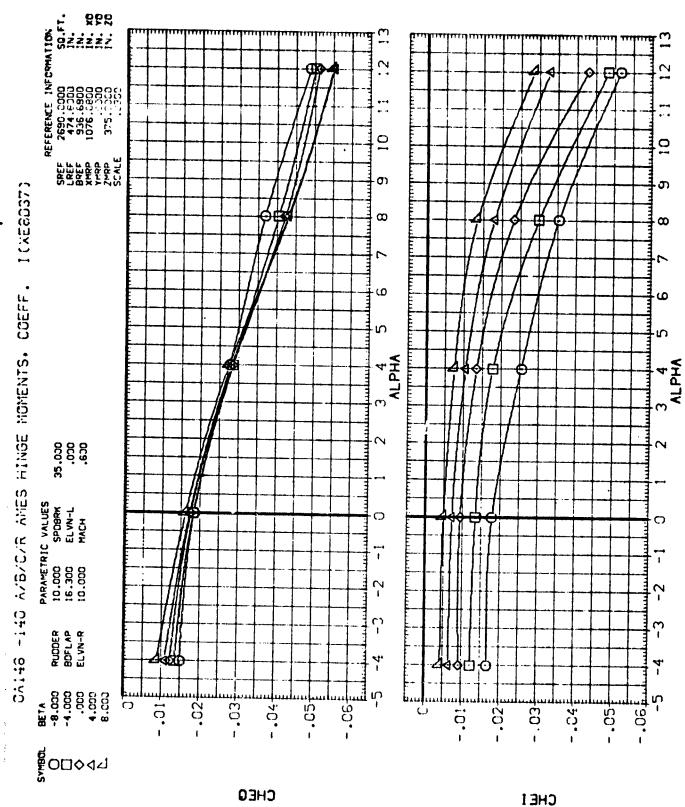
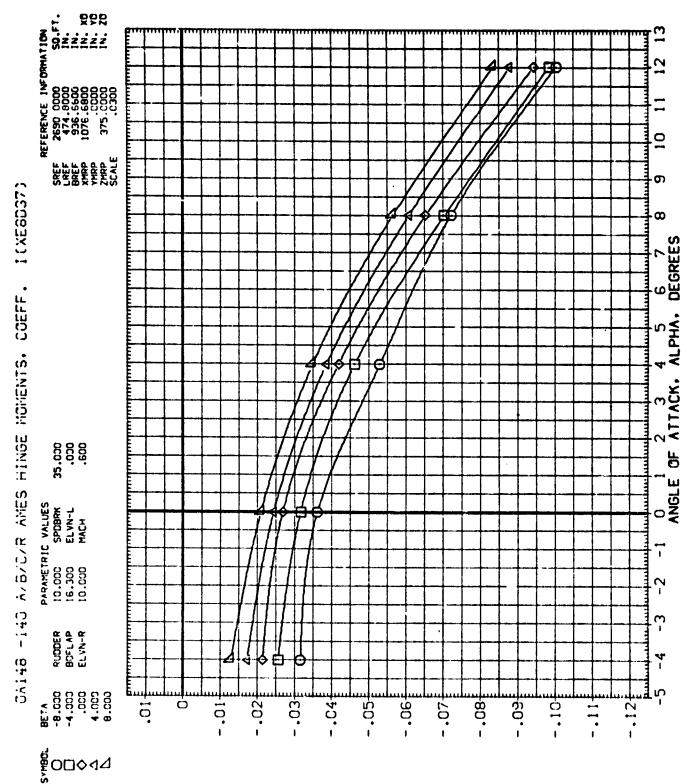


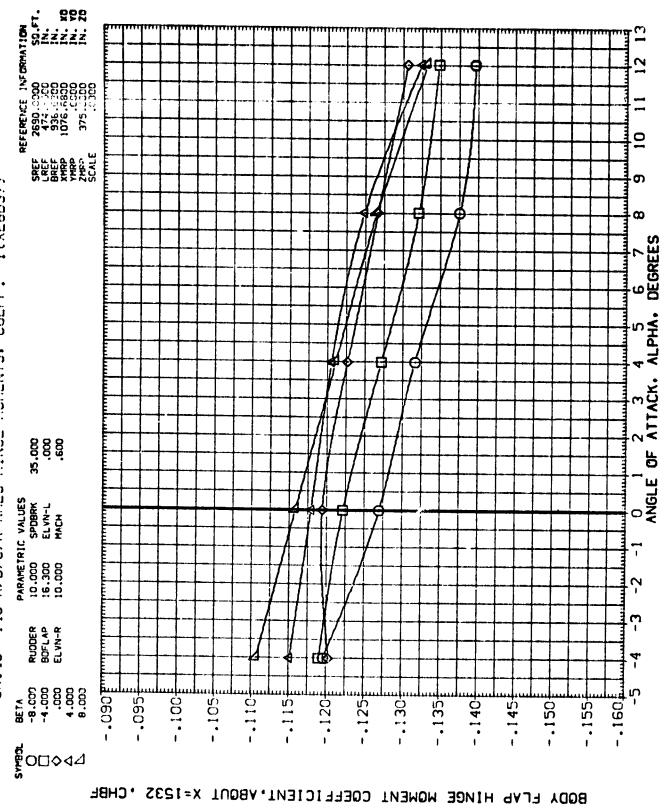
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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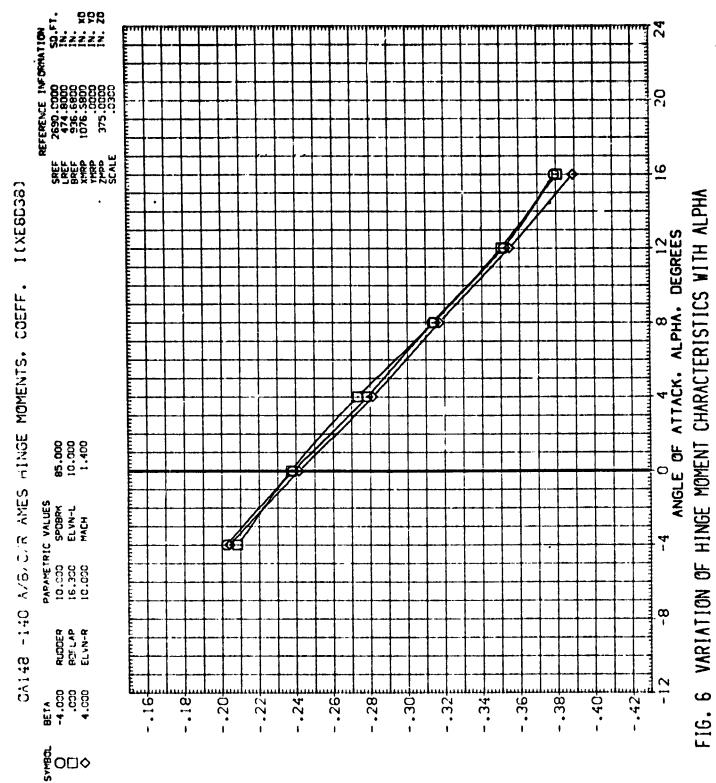
HINGE MOMENT CHARACTERISTICS WITH ALPHA

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TOTAL ELEVON HINGE MOMENT COEFFICIENT. ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF



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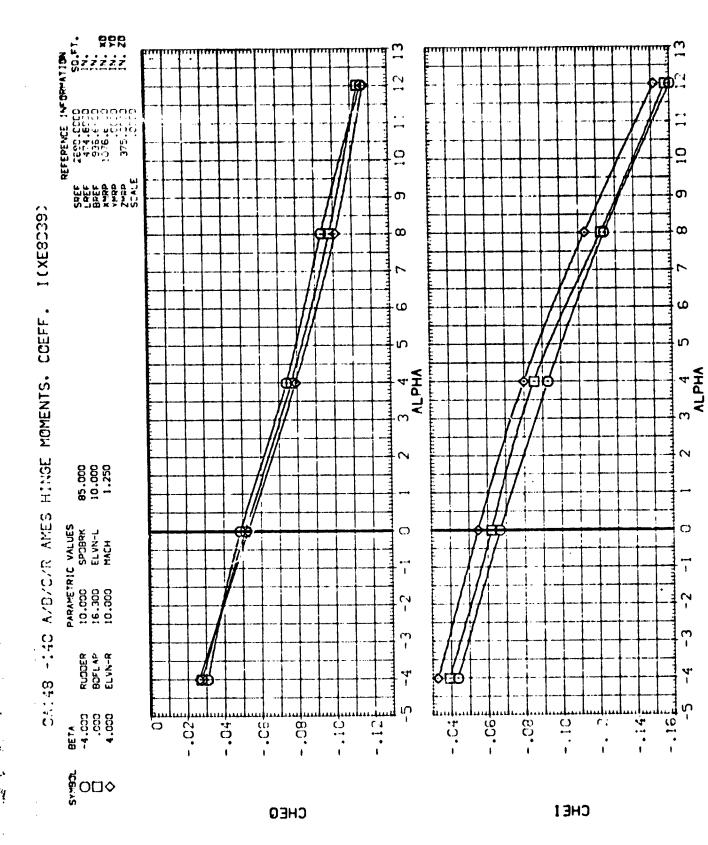
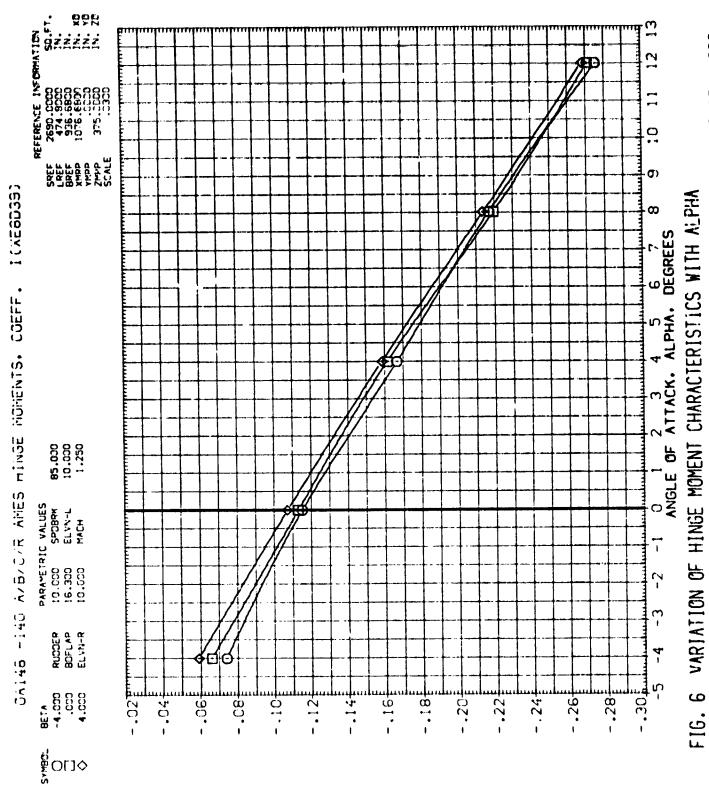


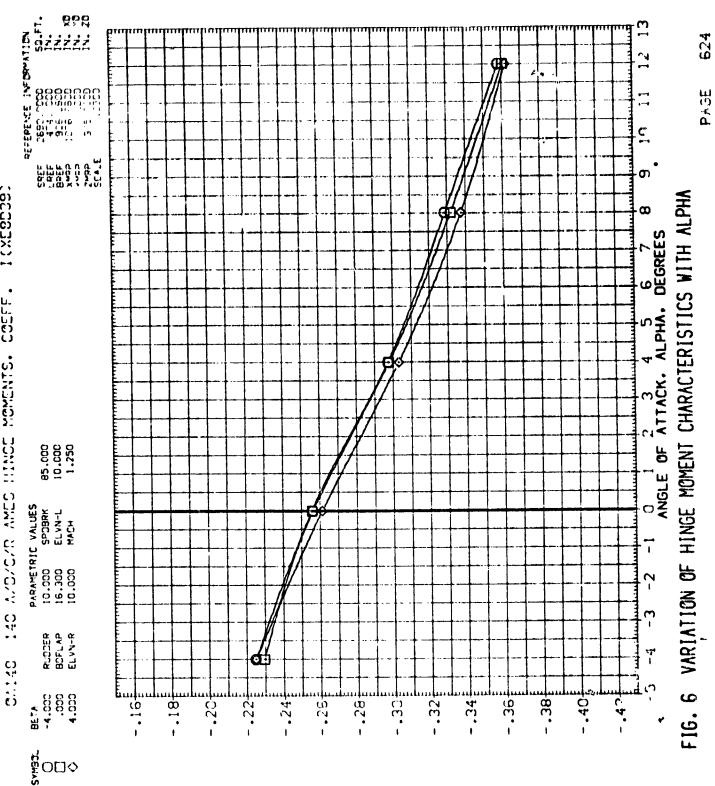
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

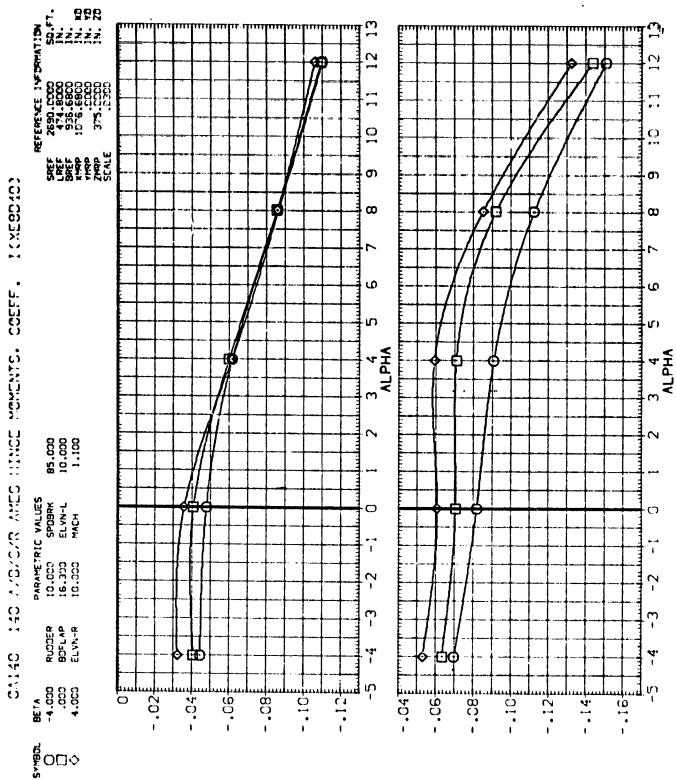
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 . CHBF





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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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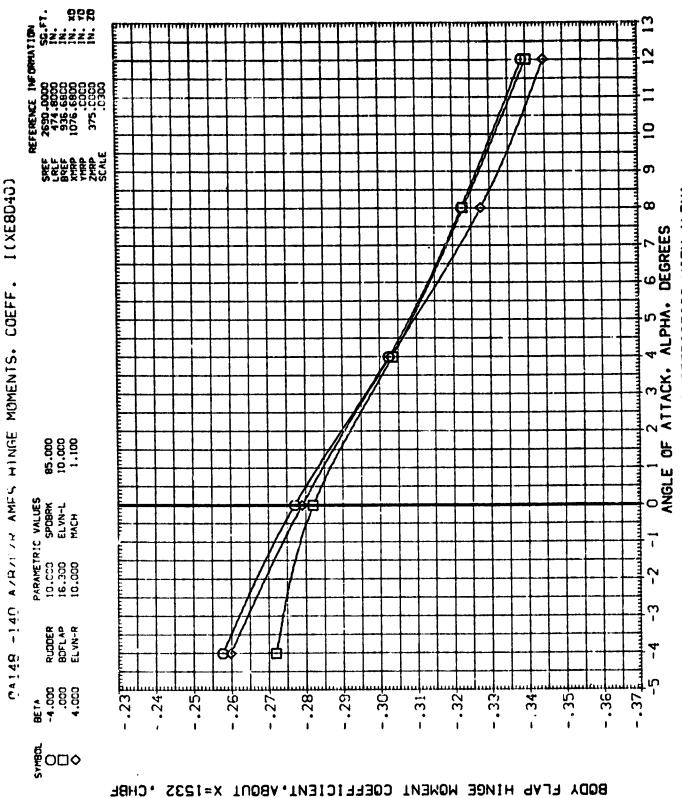
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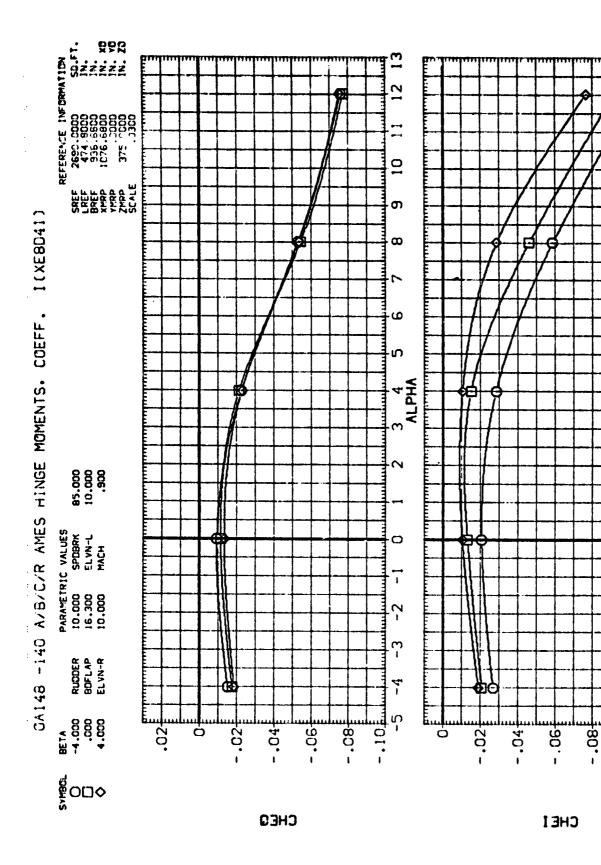
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTI

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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA 3 4 ALPHA

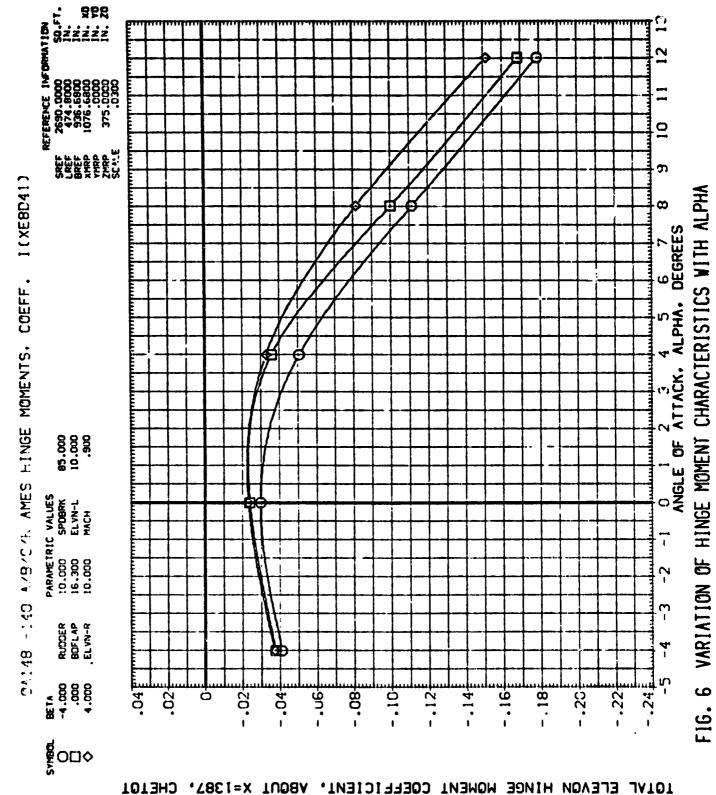
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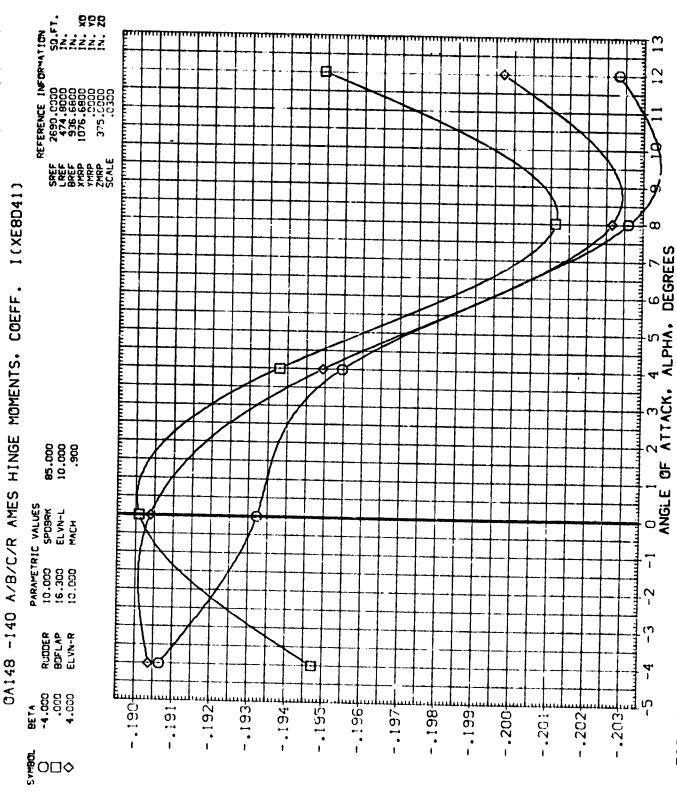


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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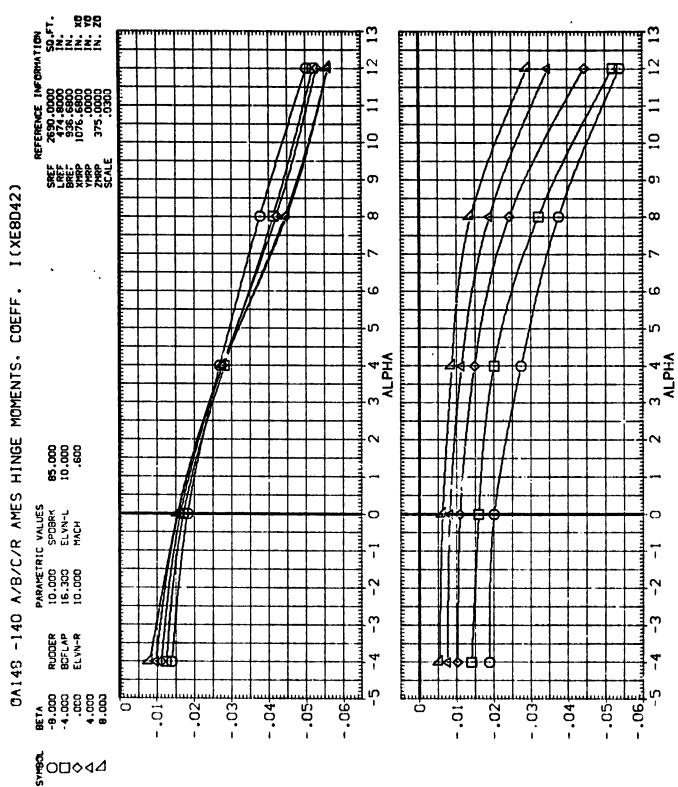
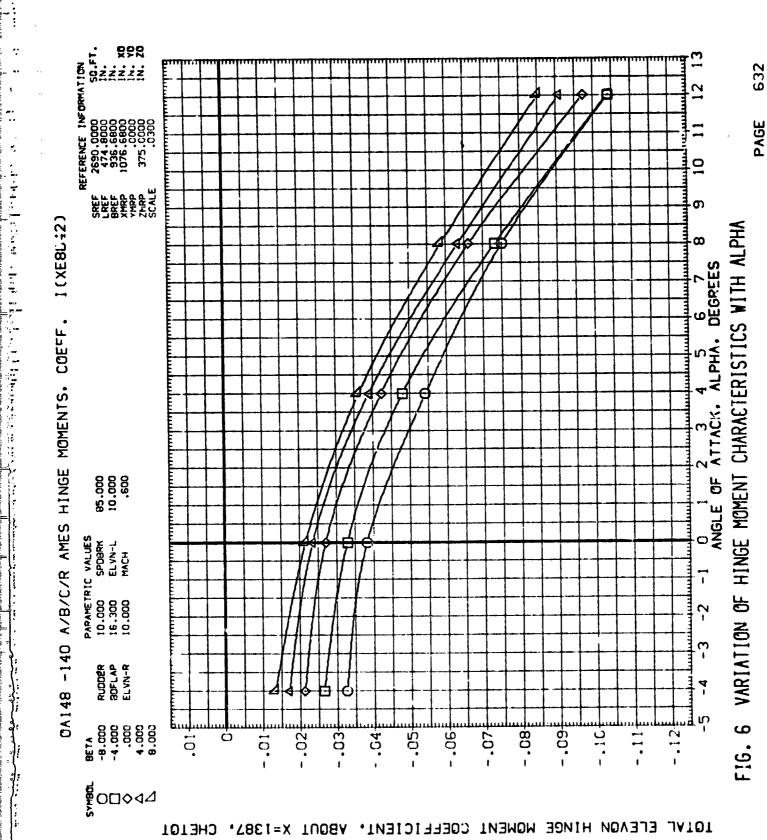


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

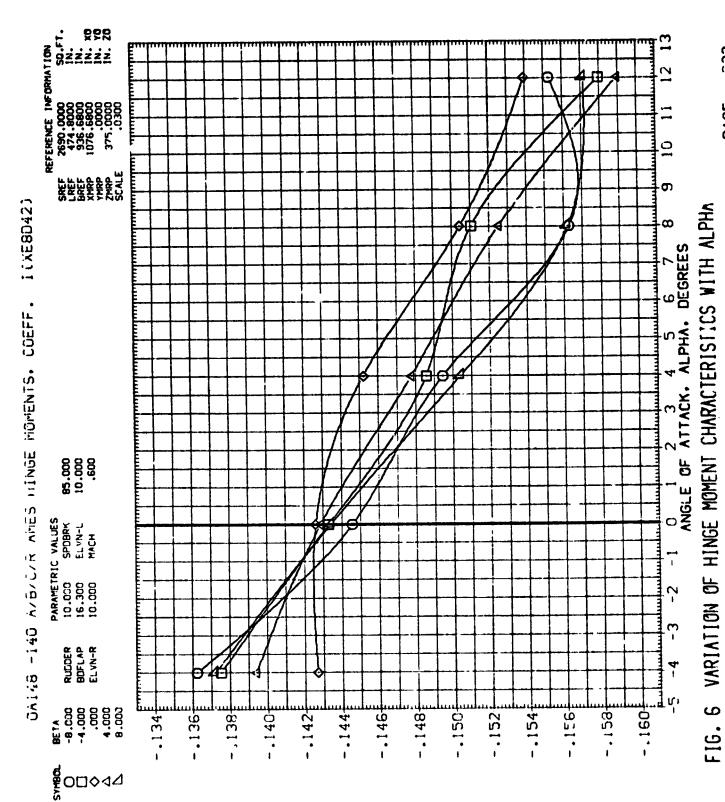
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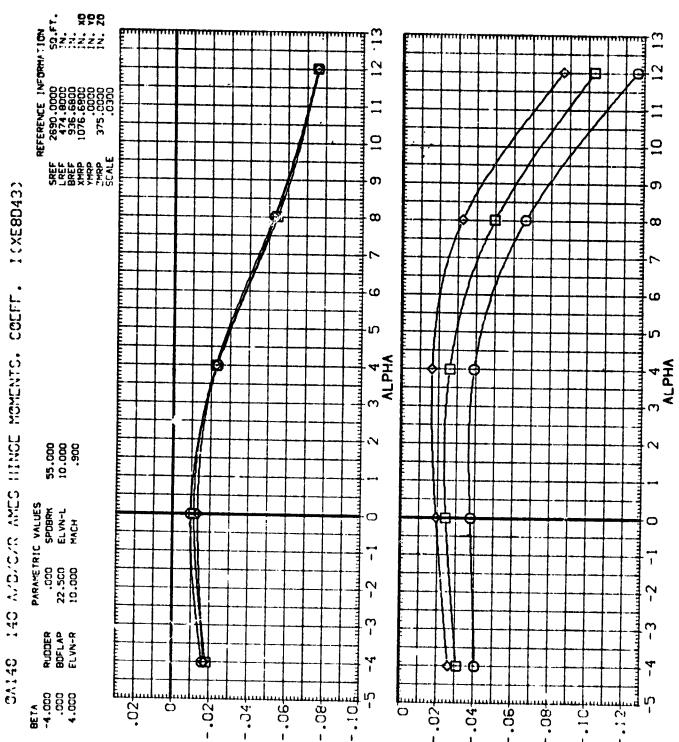
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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 . CHBF



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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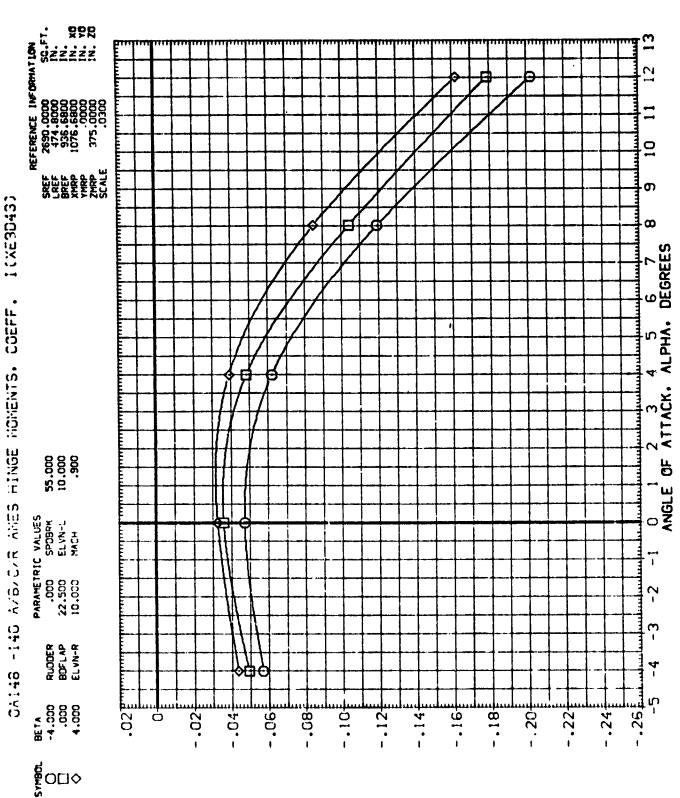
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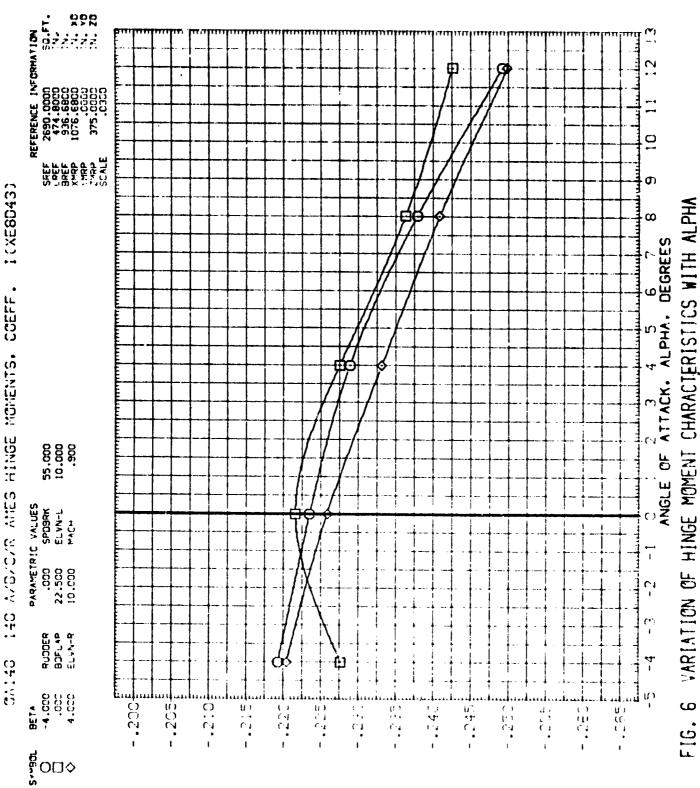
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT



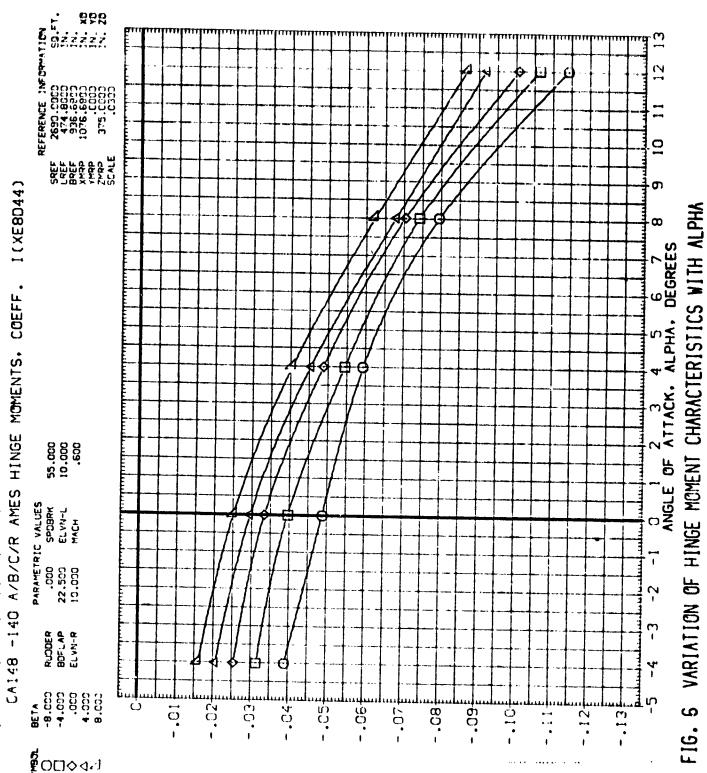
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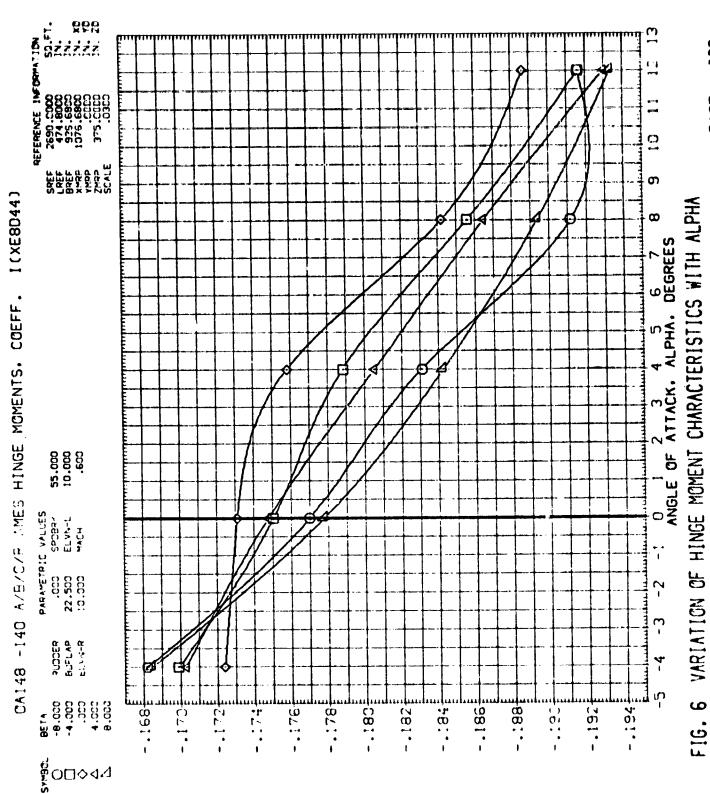
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA FIG. 6

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VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA F16. 6

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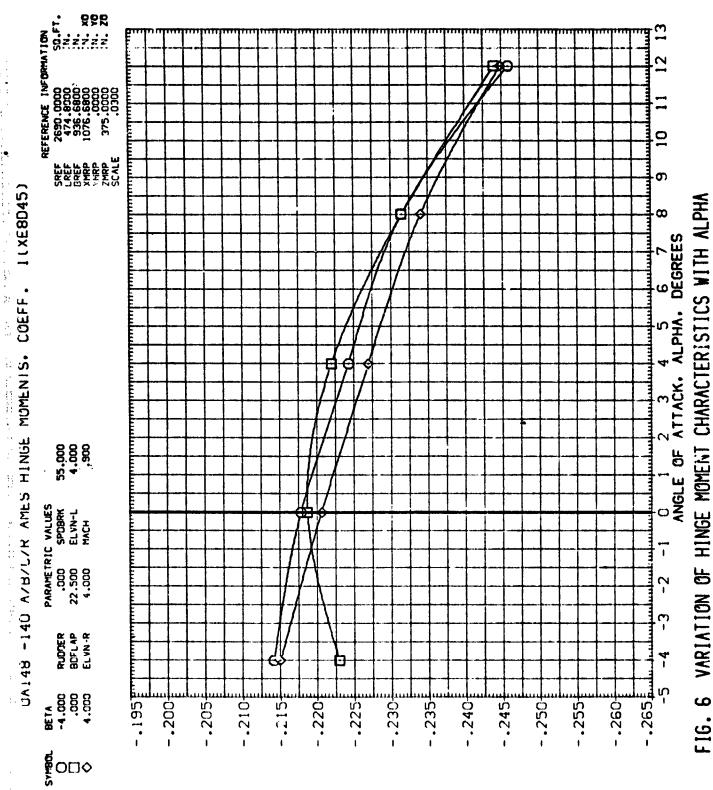
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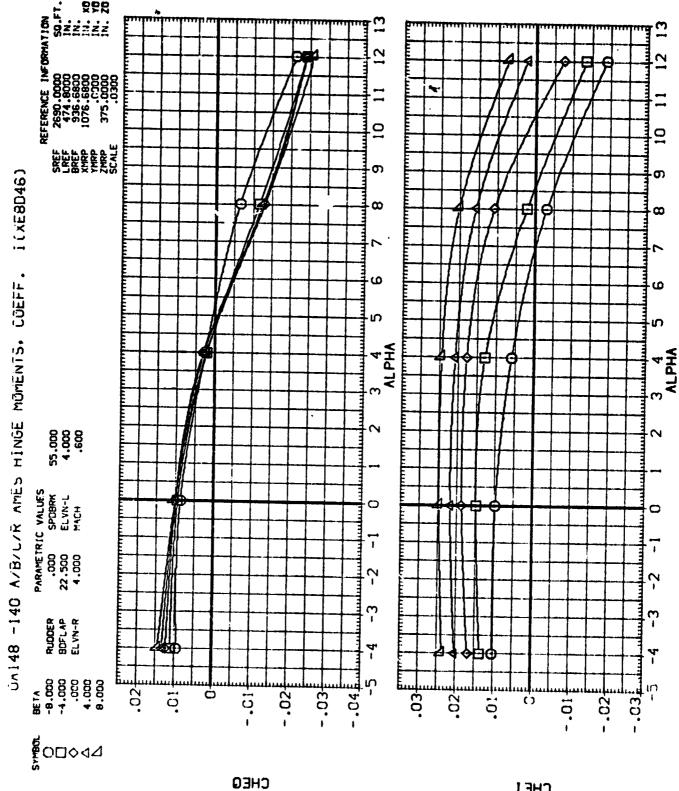
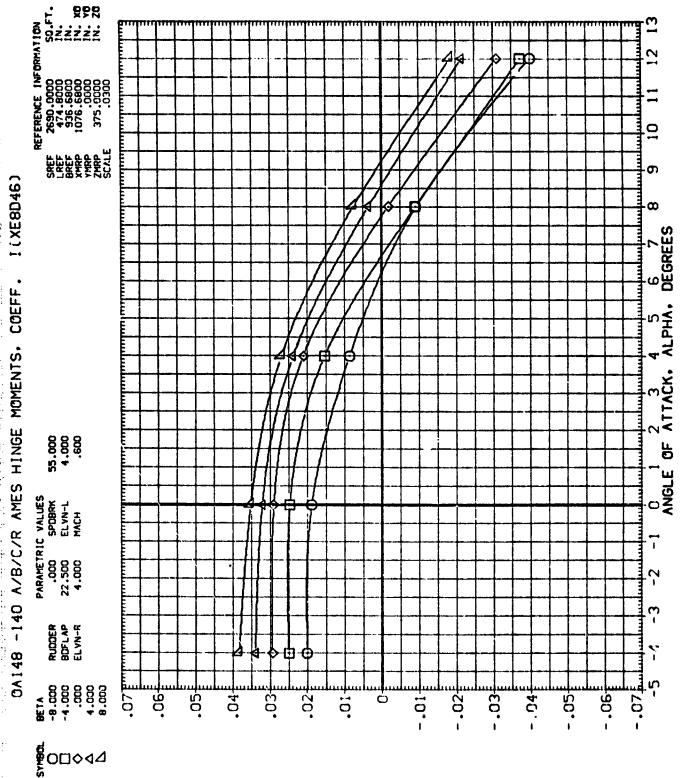


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

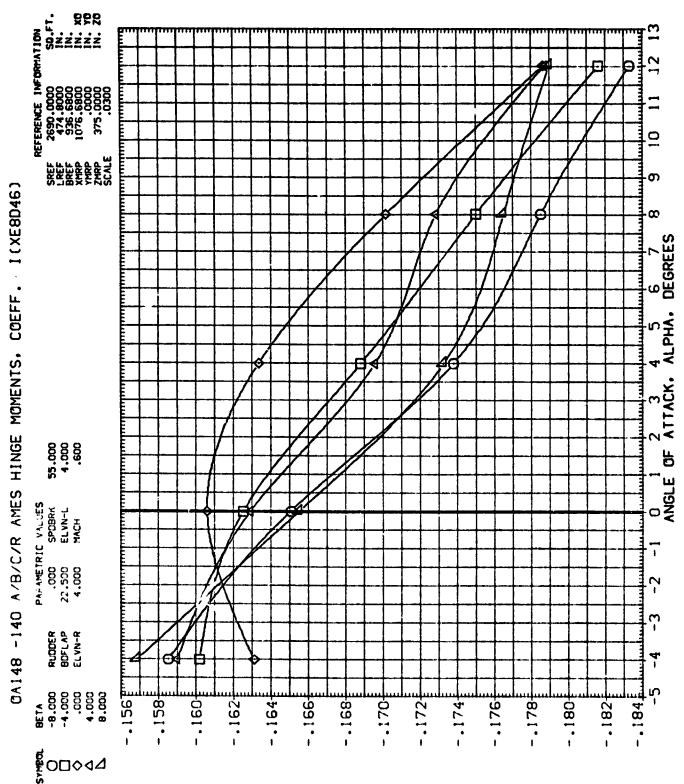
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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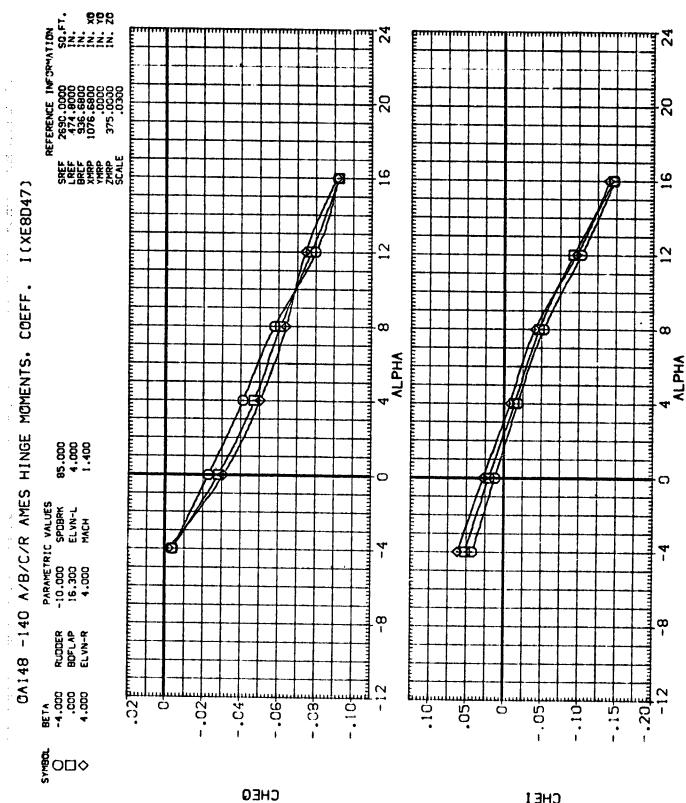


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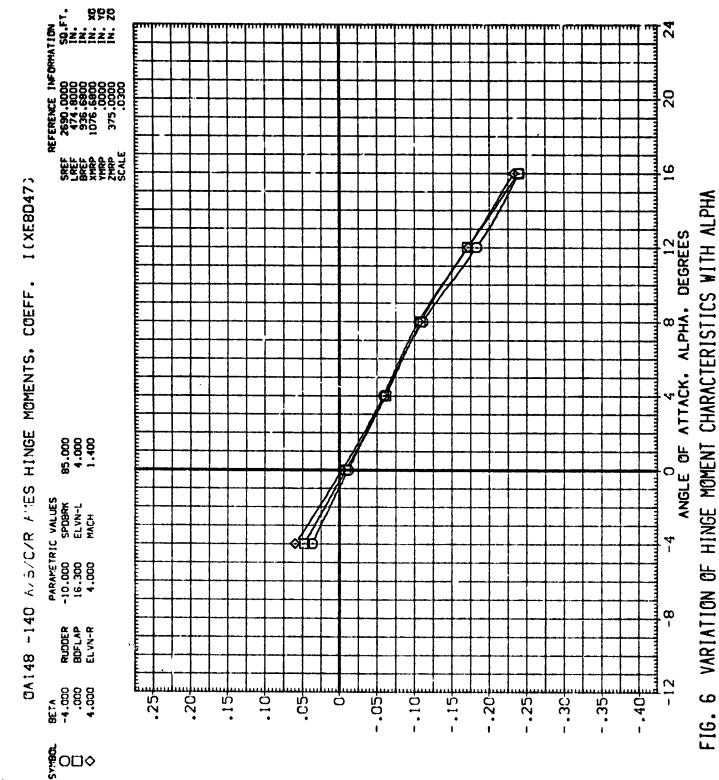
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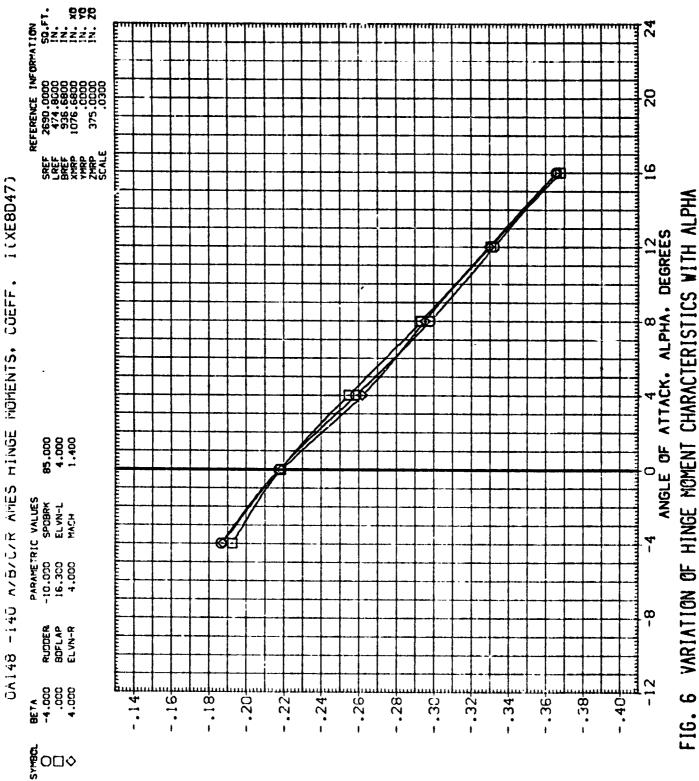
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

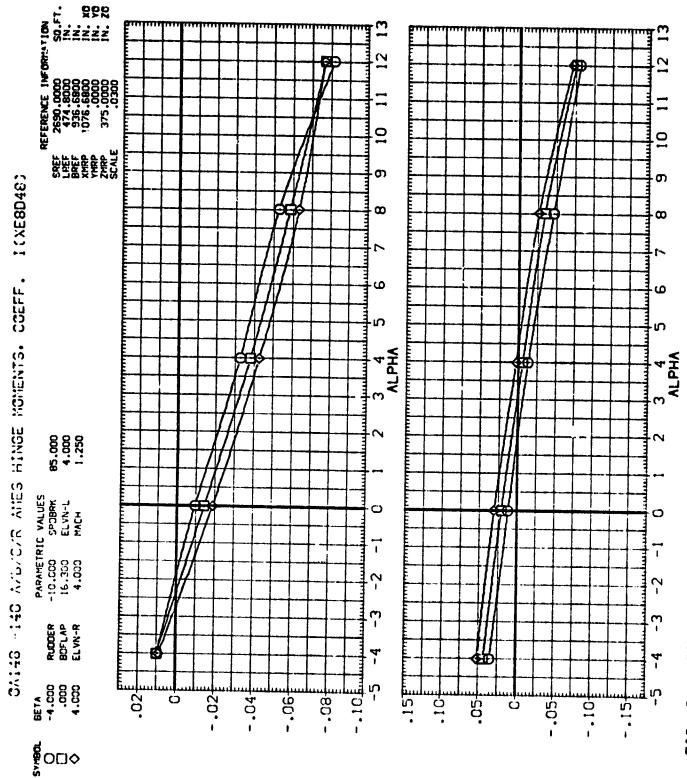


TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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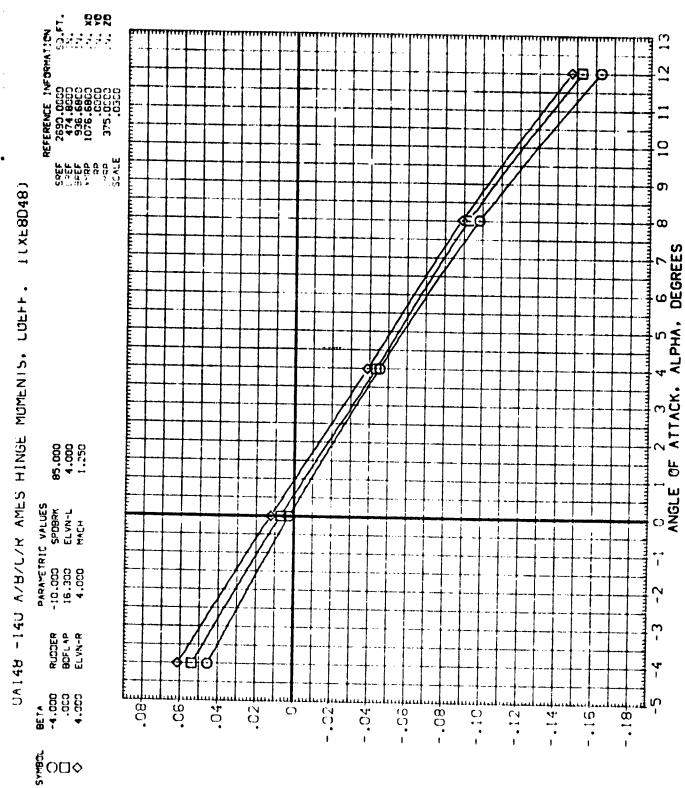


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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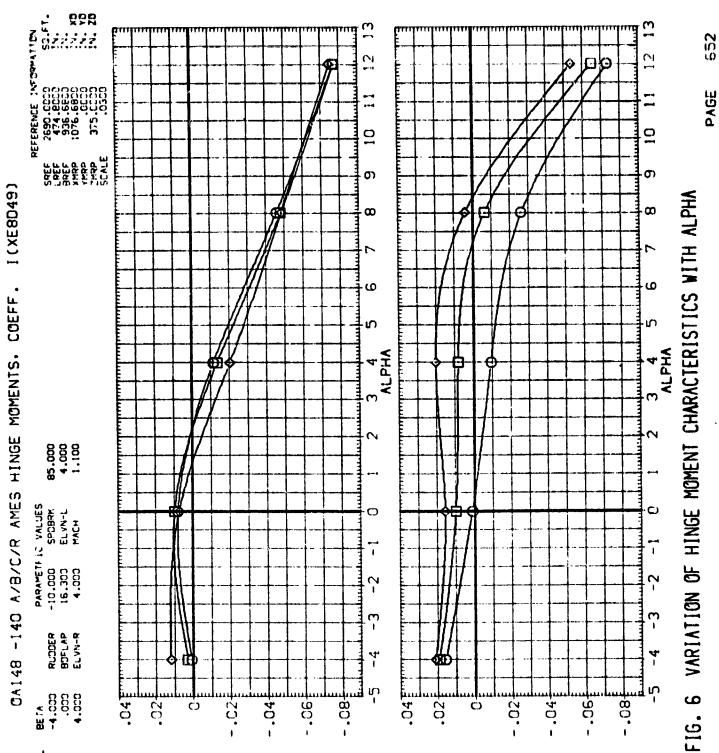
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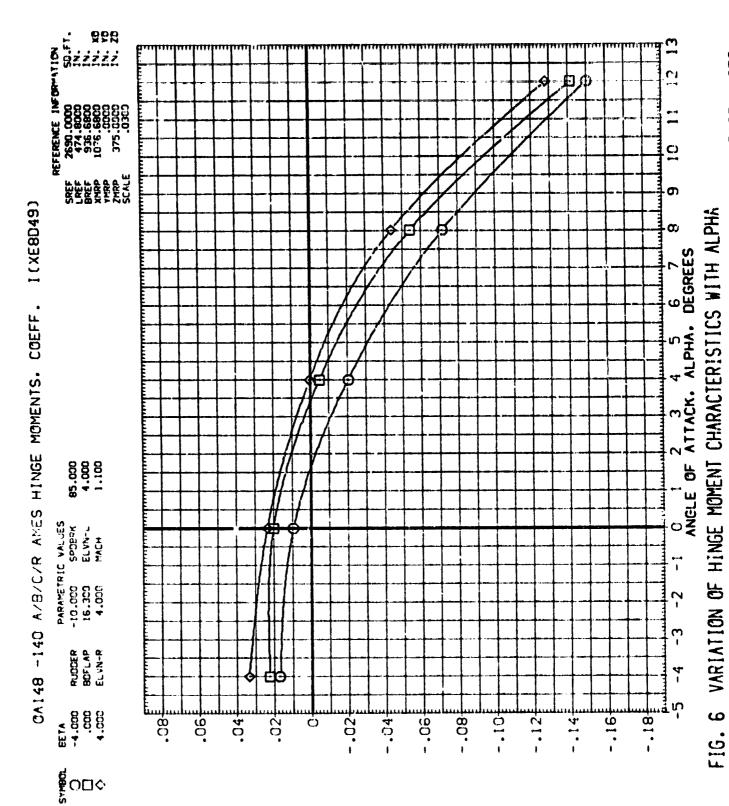
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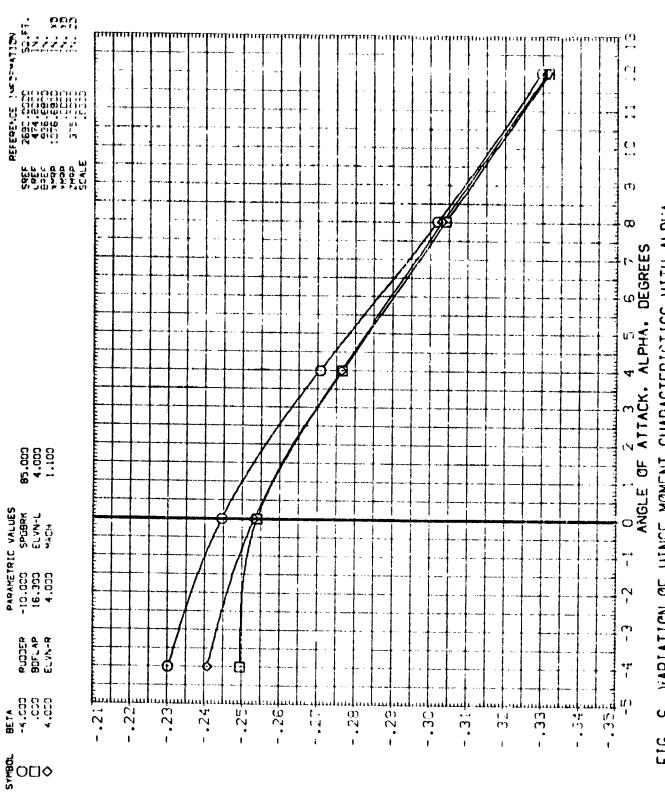
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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

FIG. 8 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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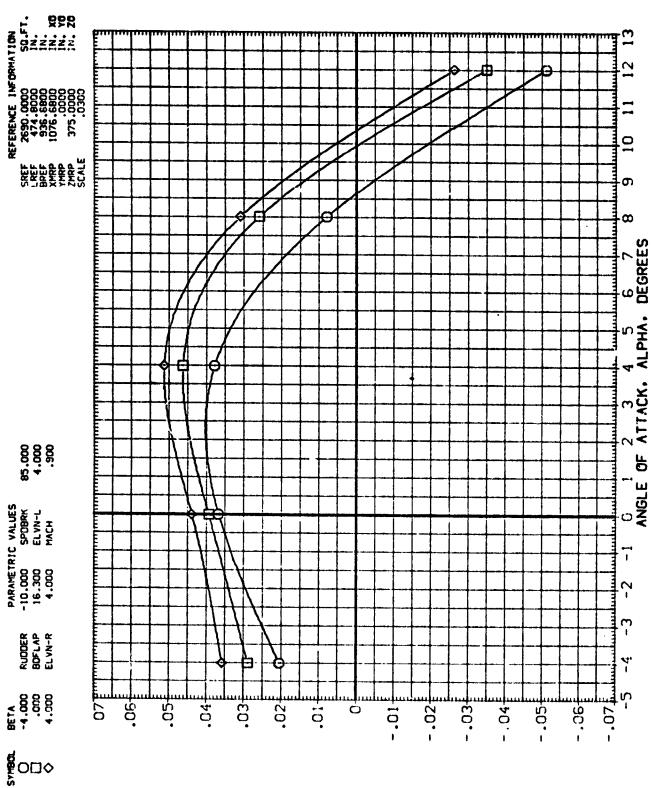
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

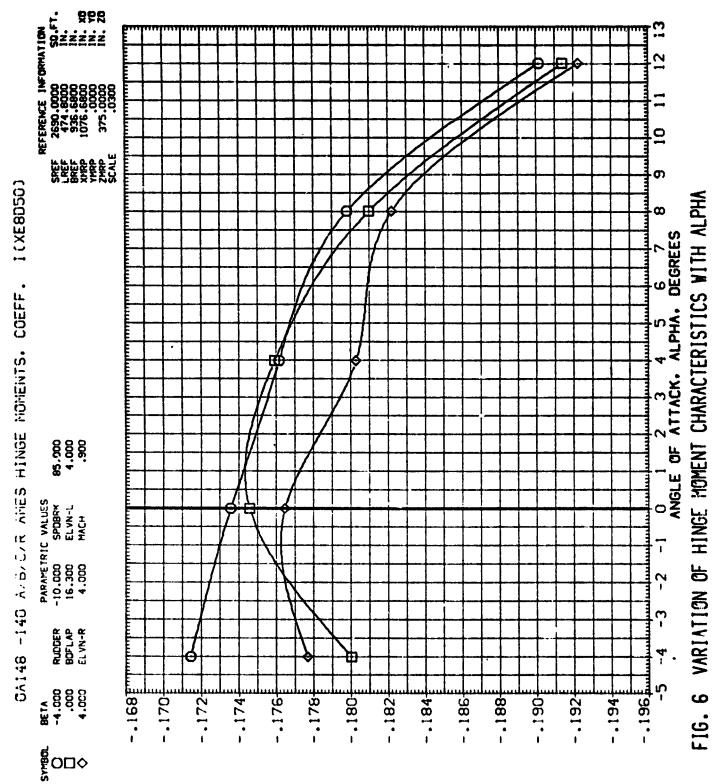
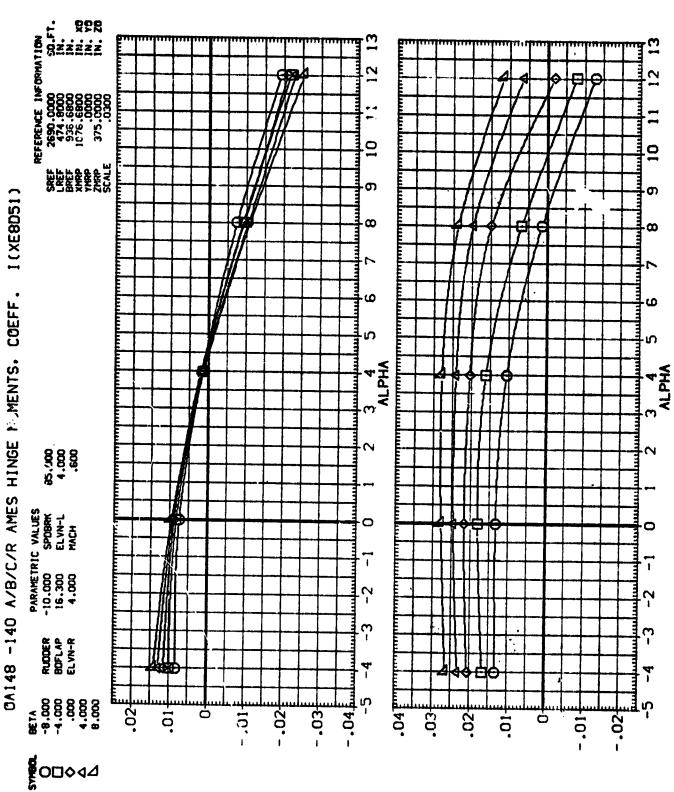




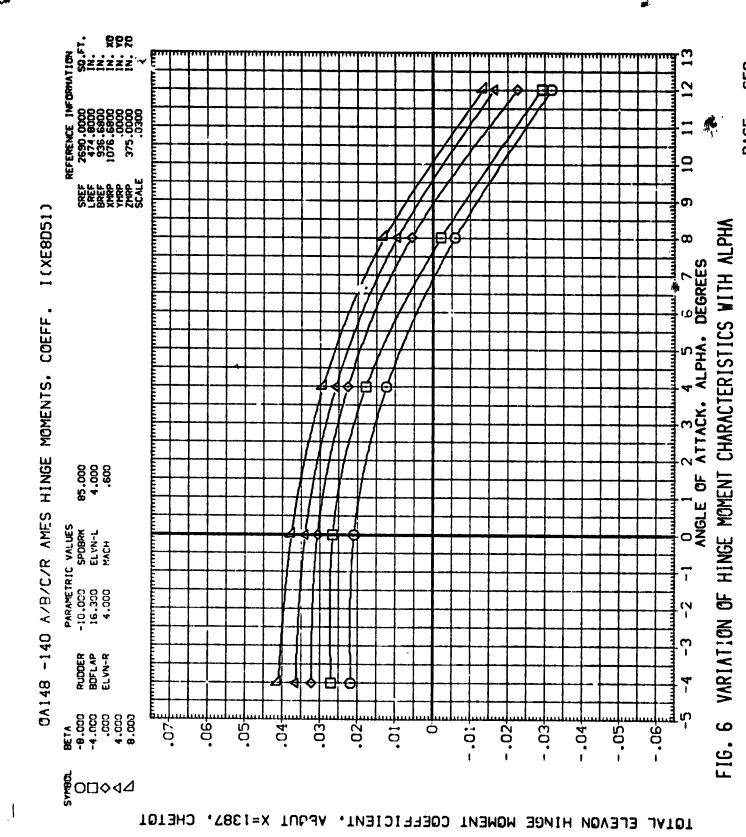
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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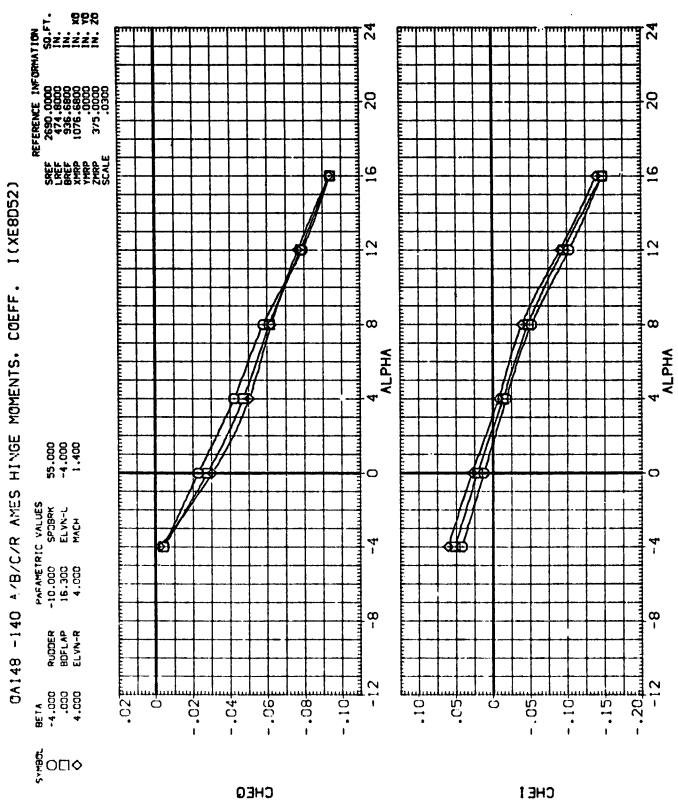
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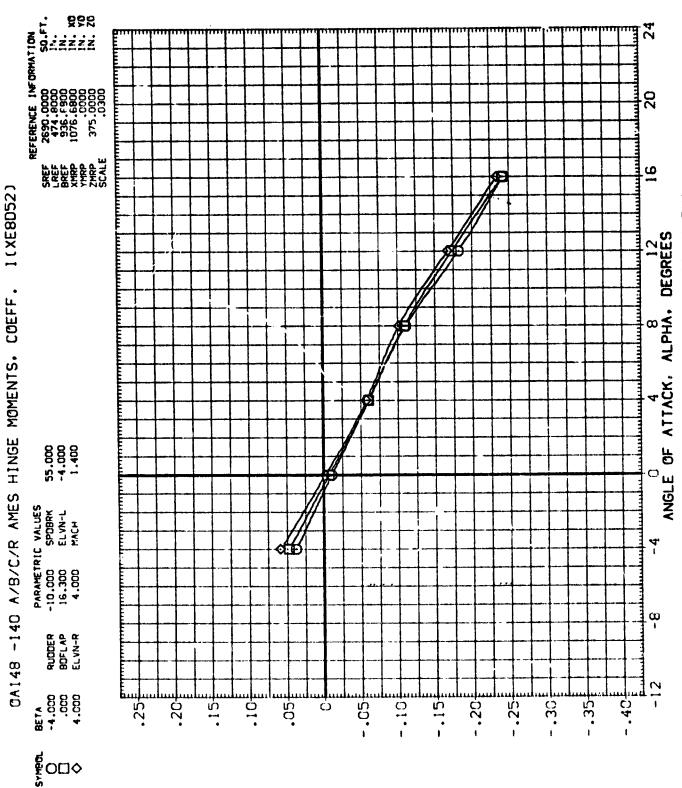
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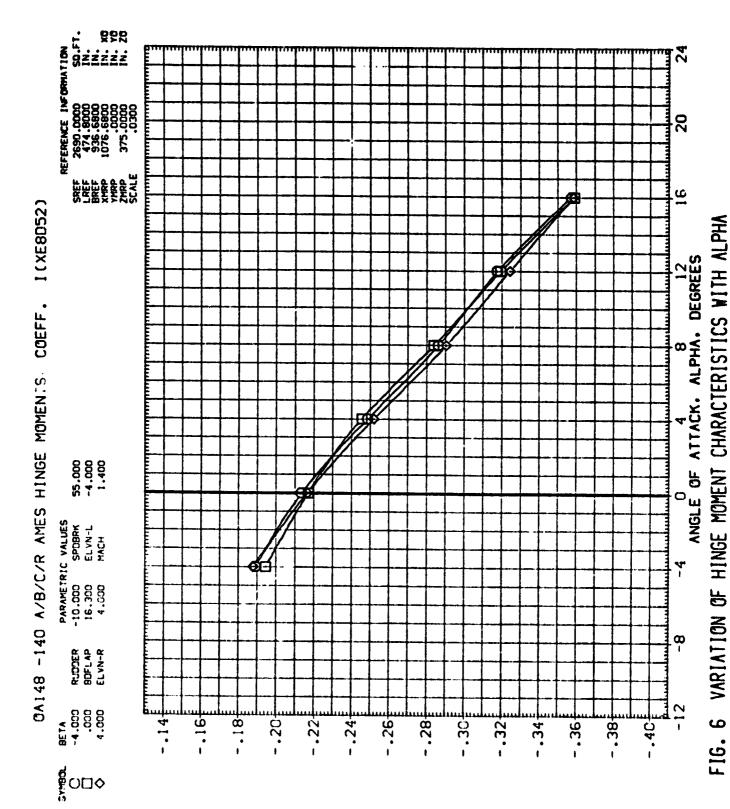


TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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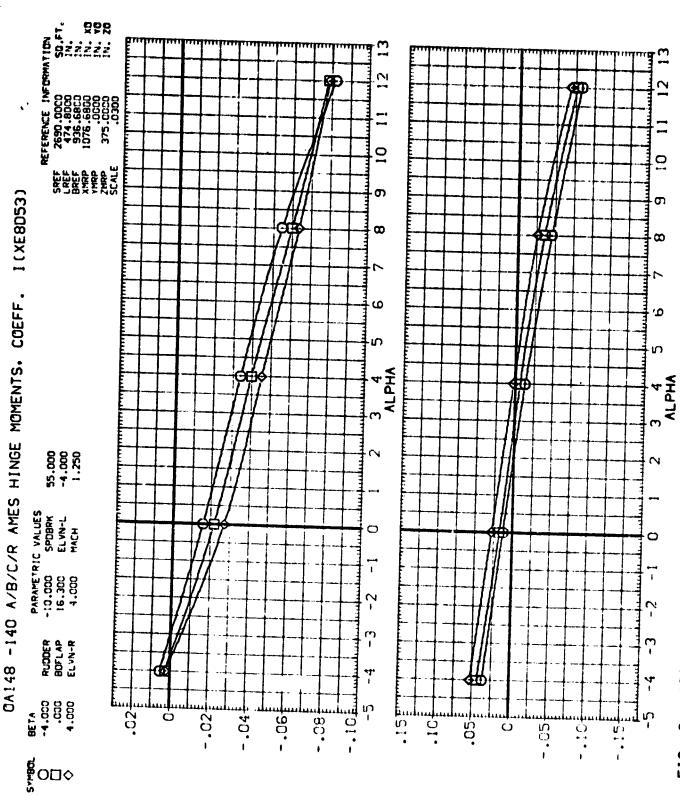
BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF



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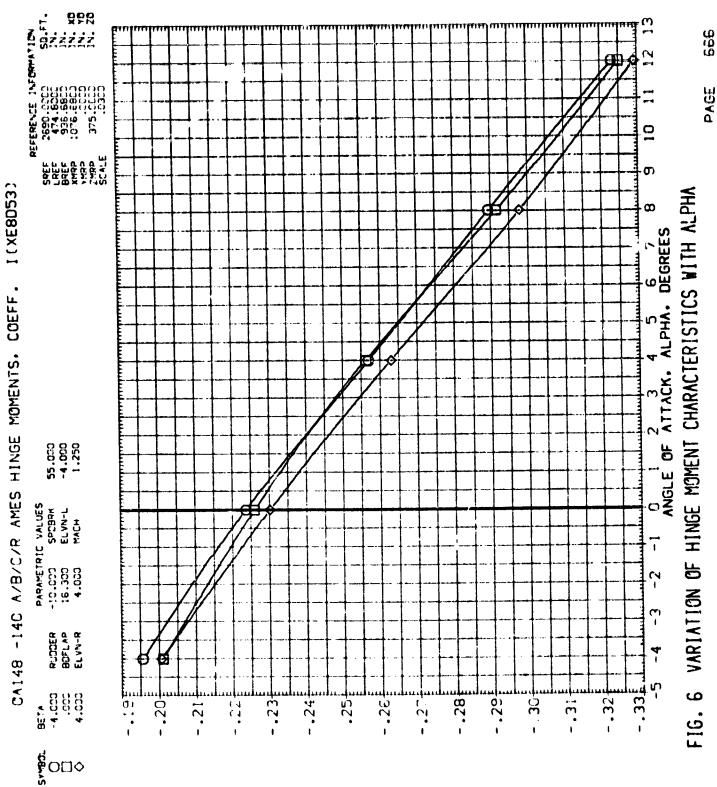


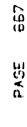
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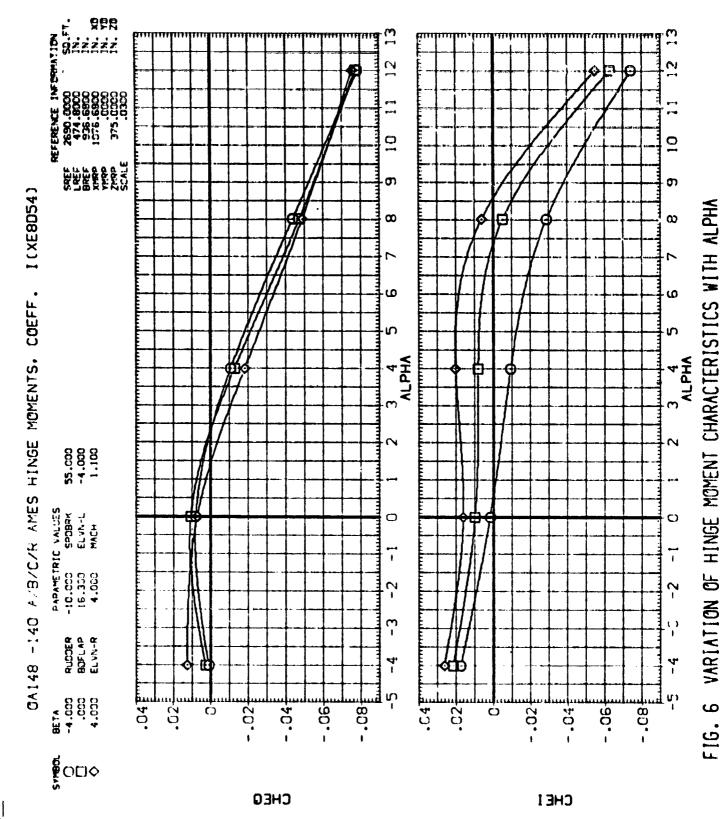
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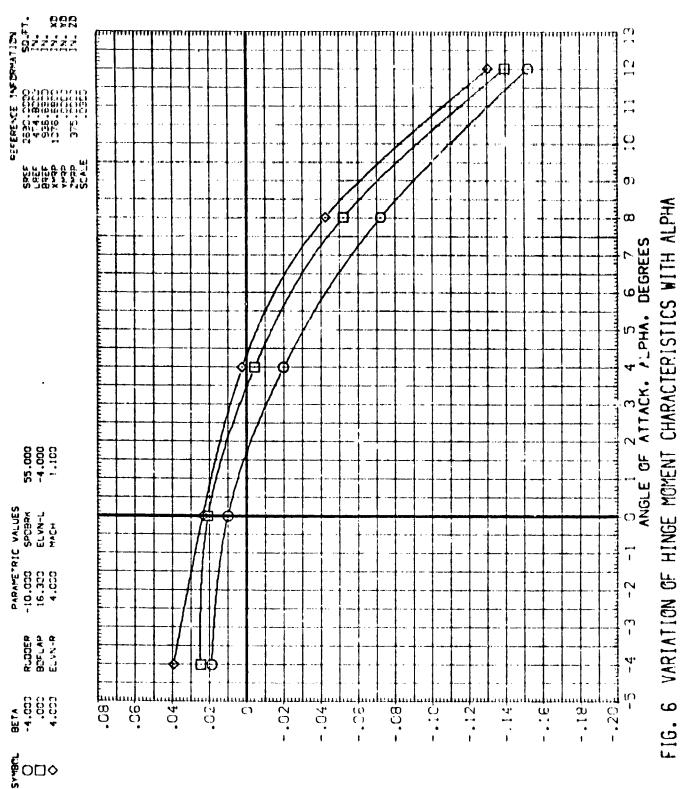
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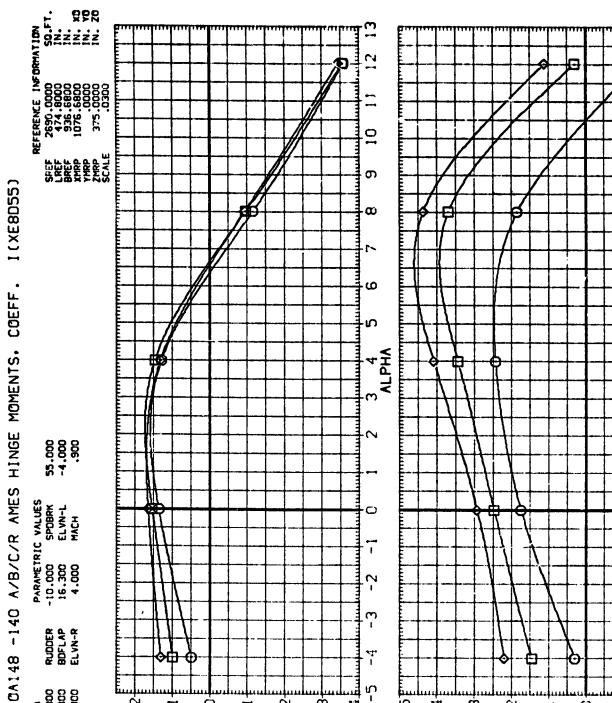
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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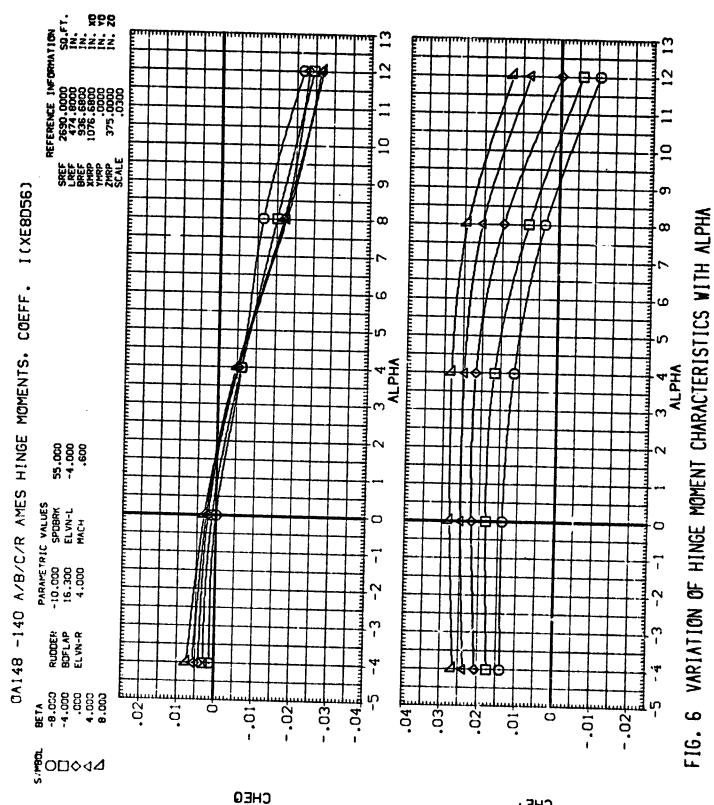
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

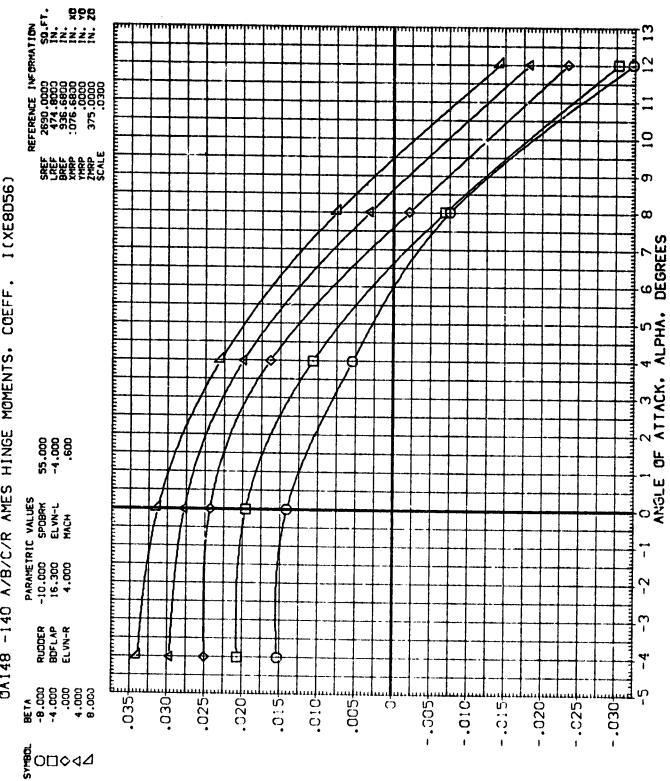
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

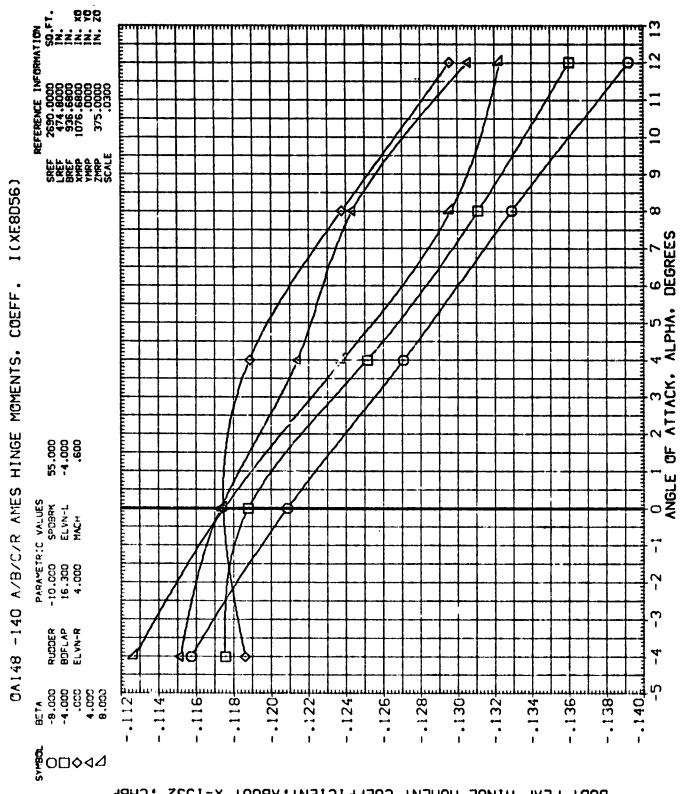


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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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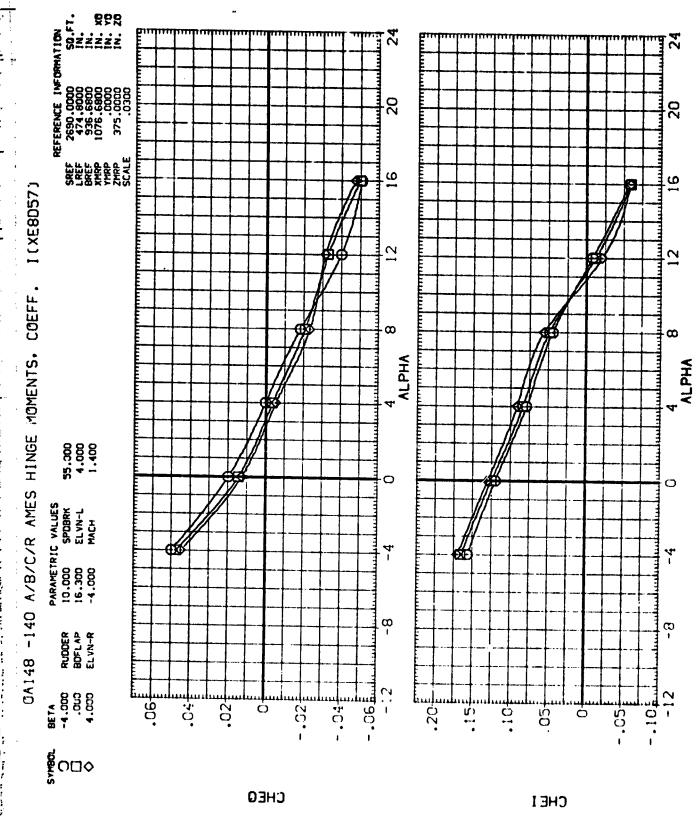
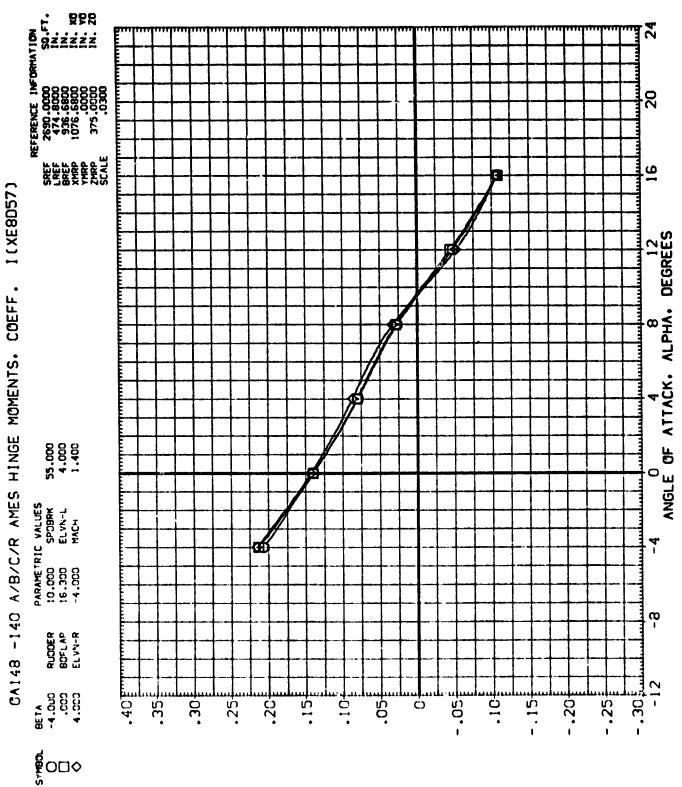


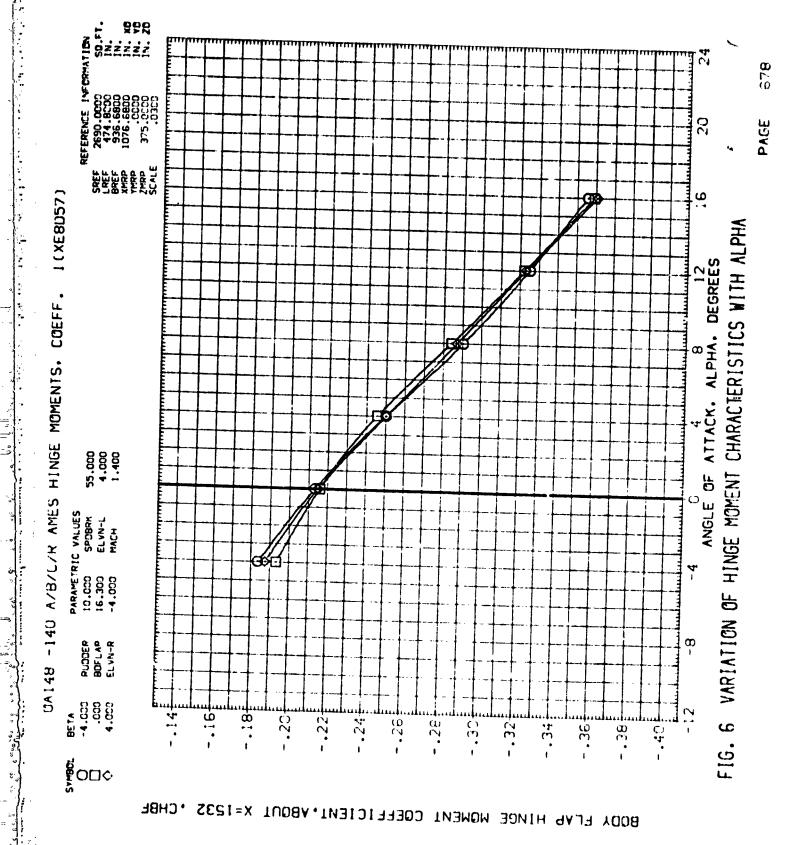
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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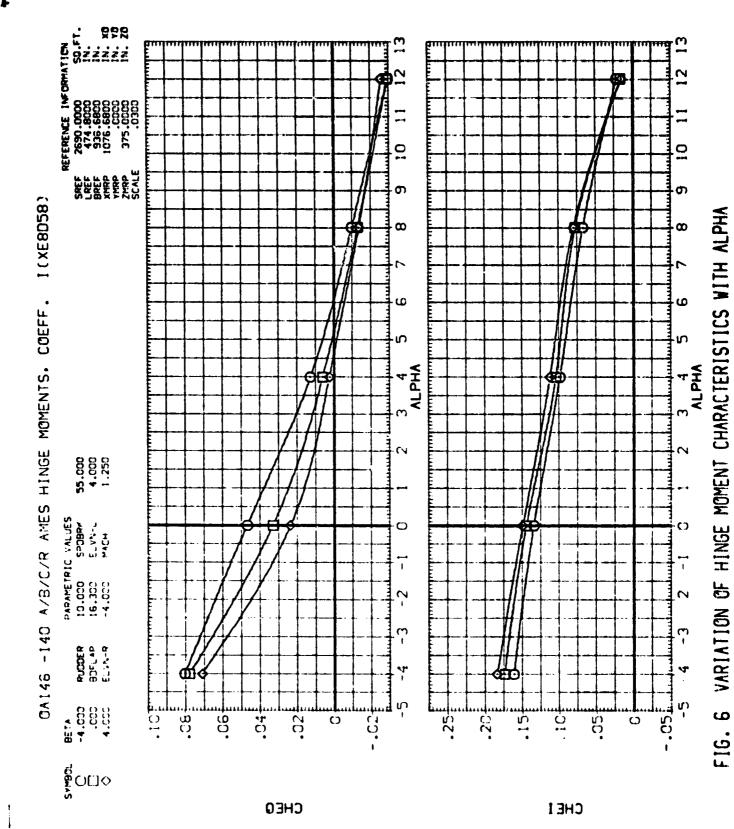
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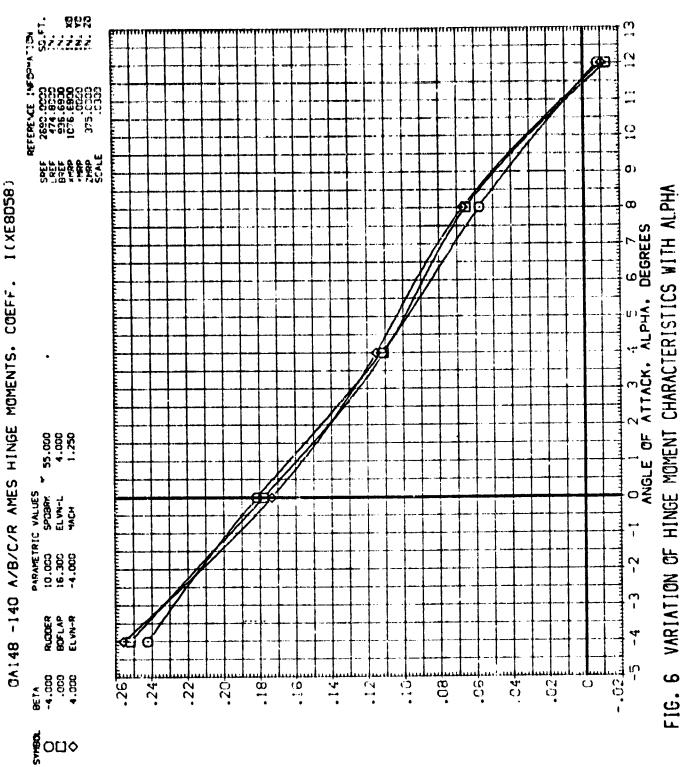


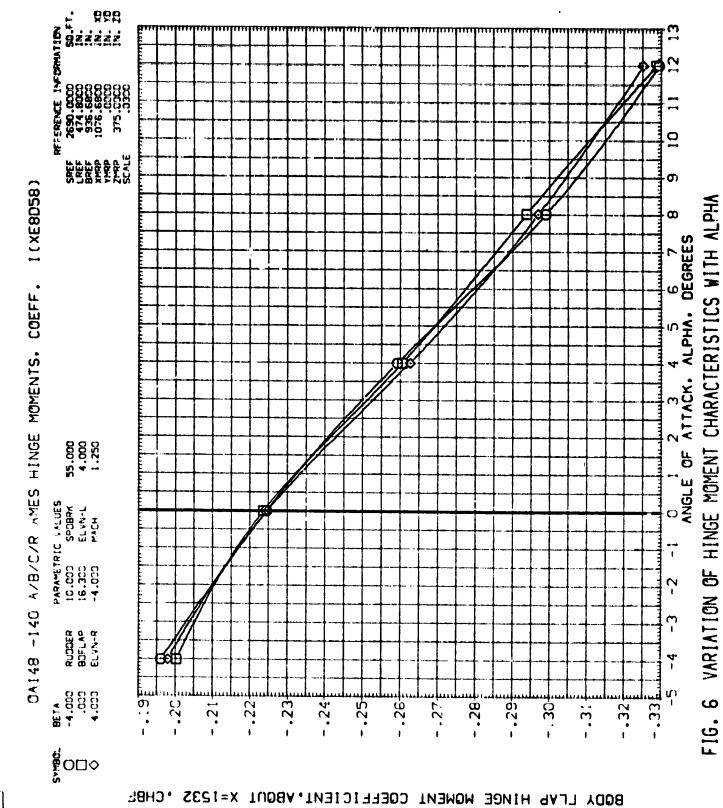
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT











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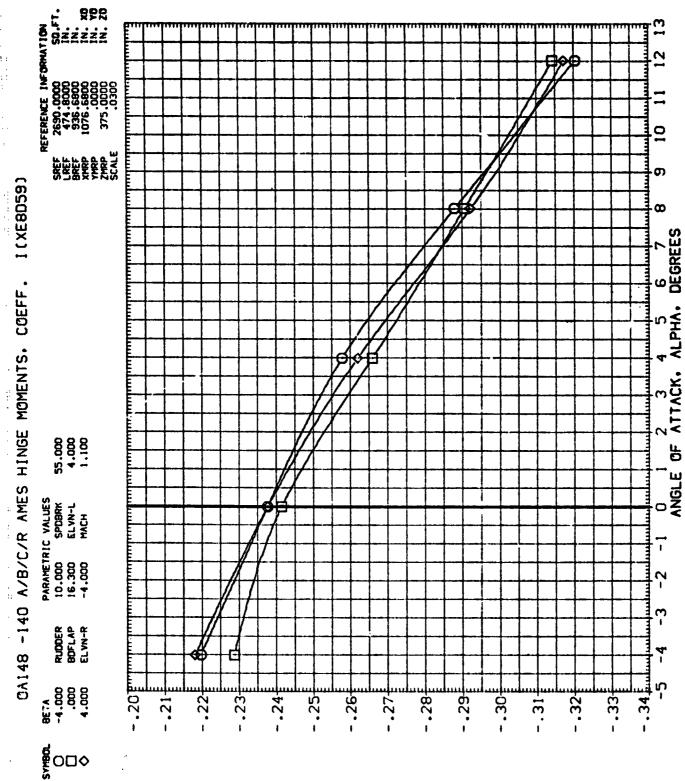
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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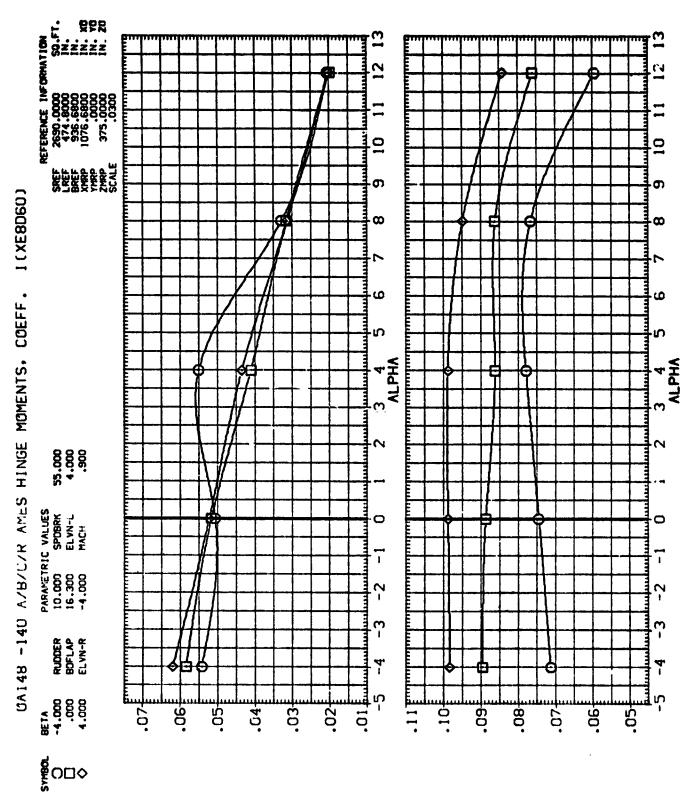


BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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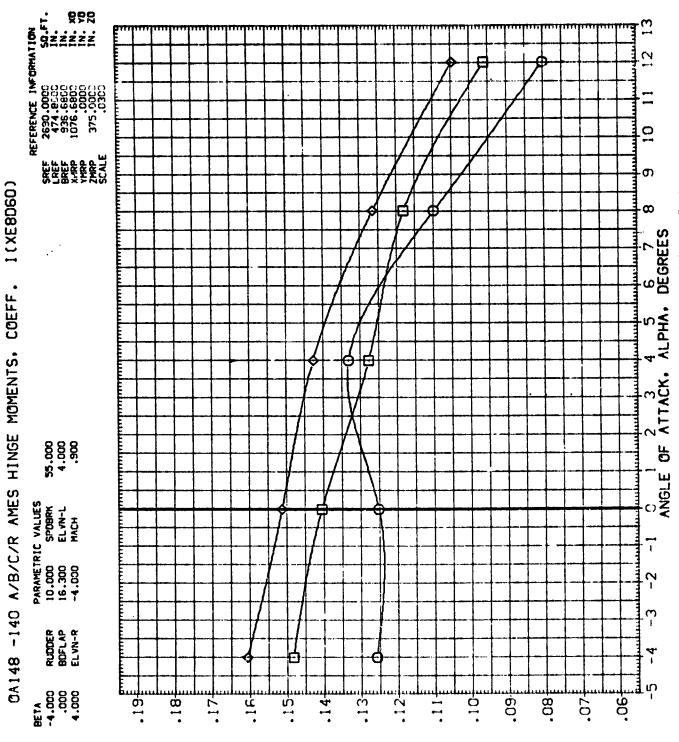
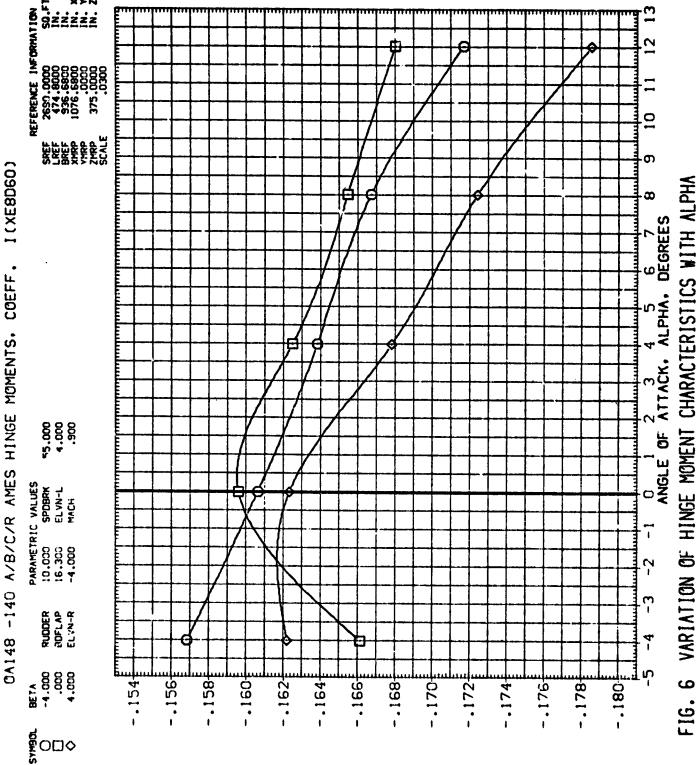


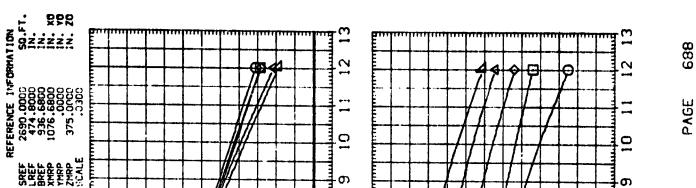
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

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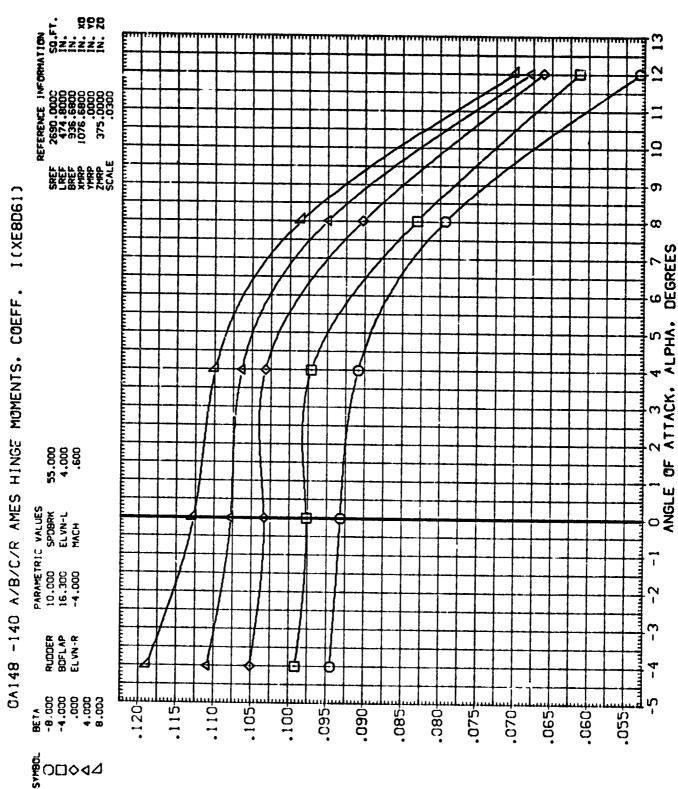


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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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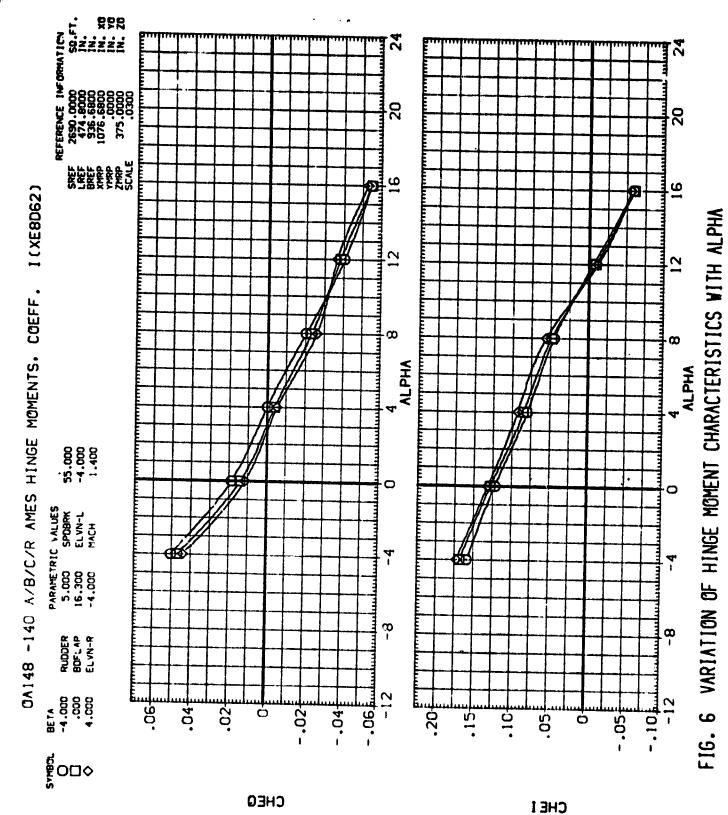
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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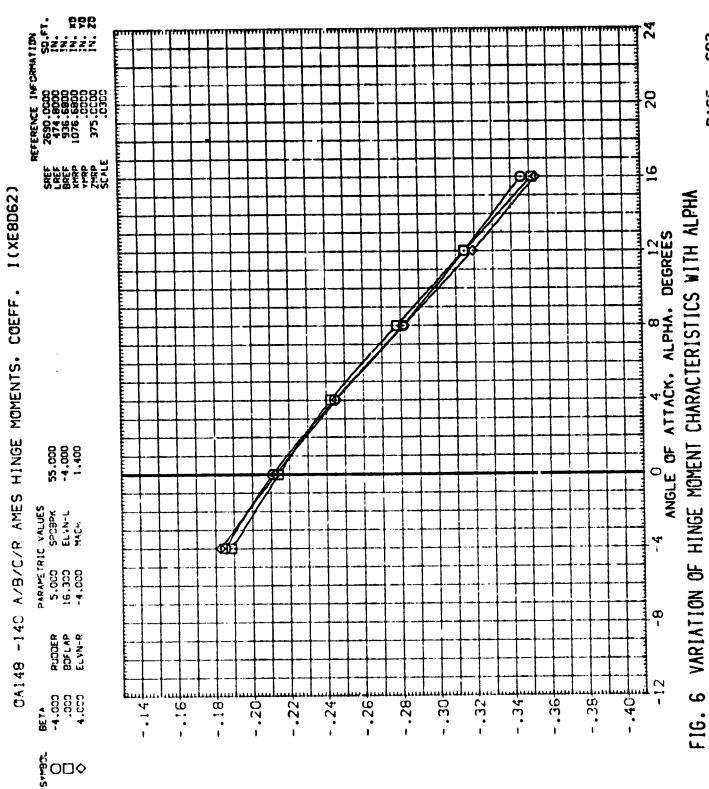




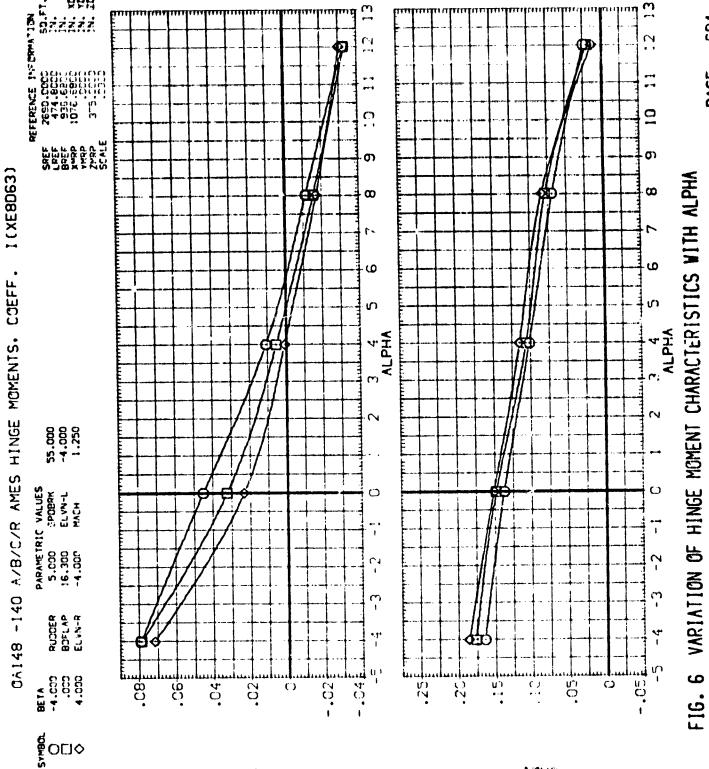
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIFIION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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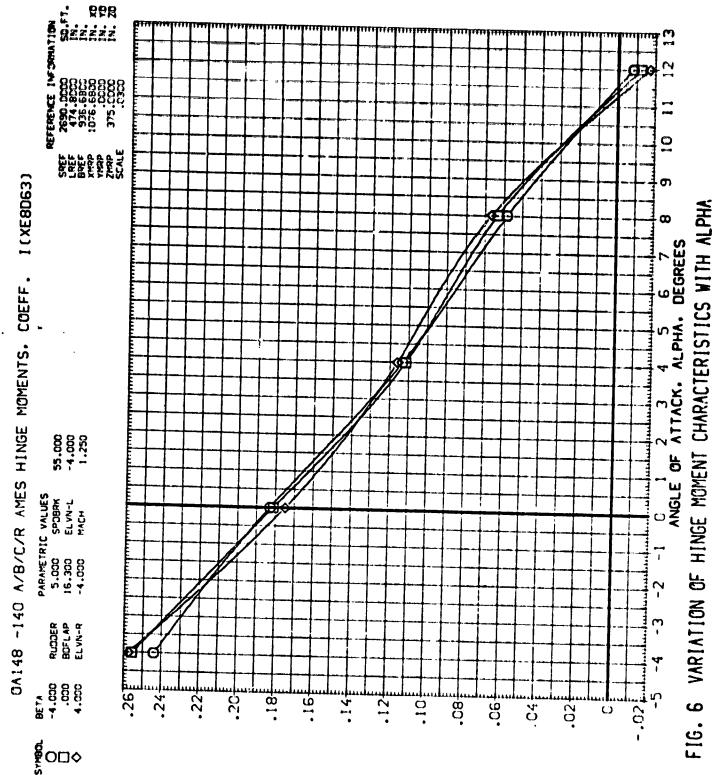






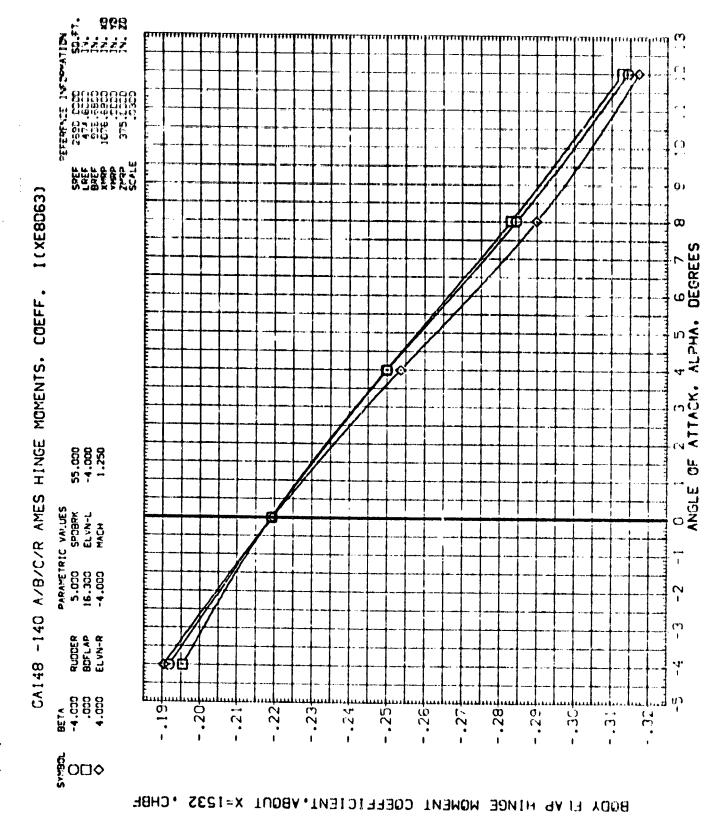
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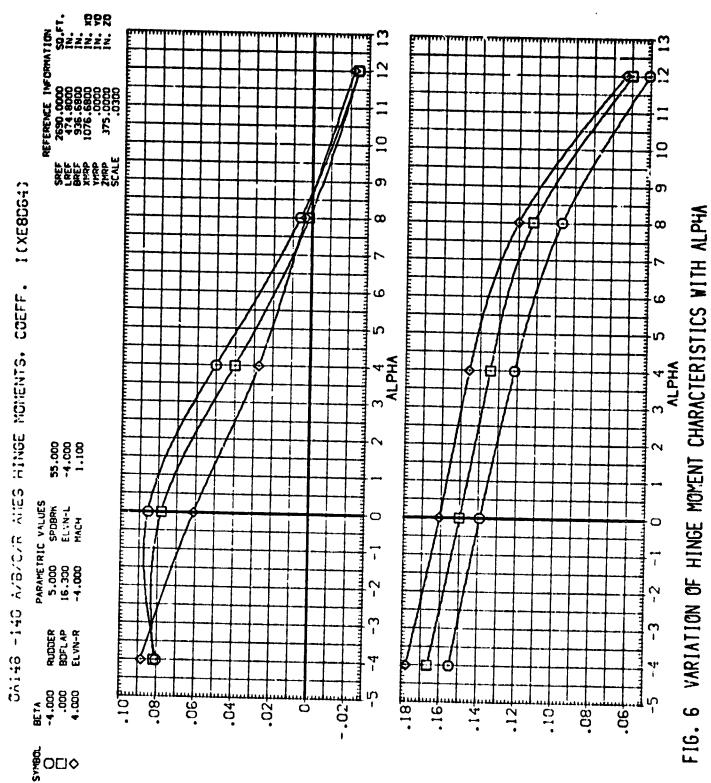
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VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA F.[G. 6

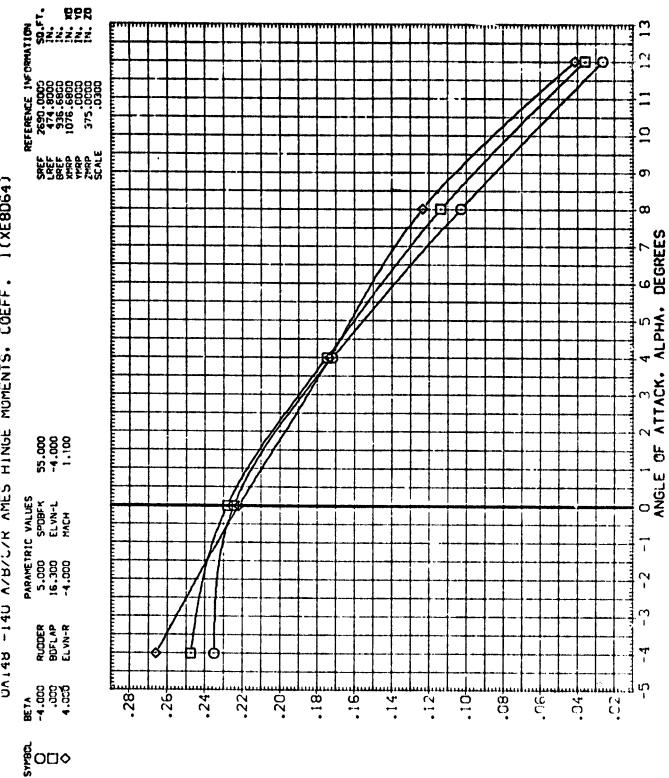
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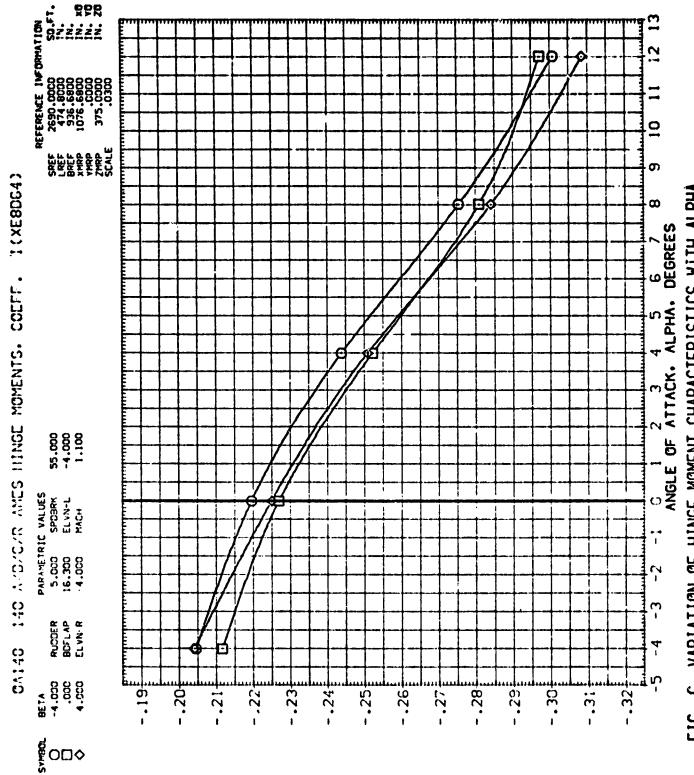
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

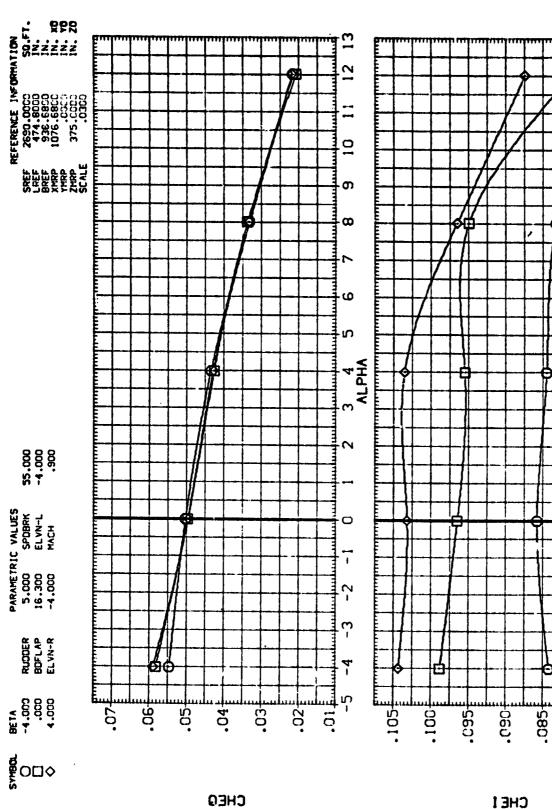


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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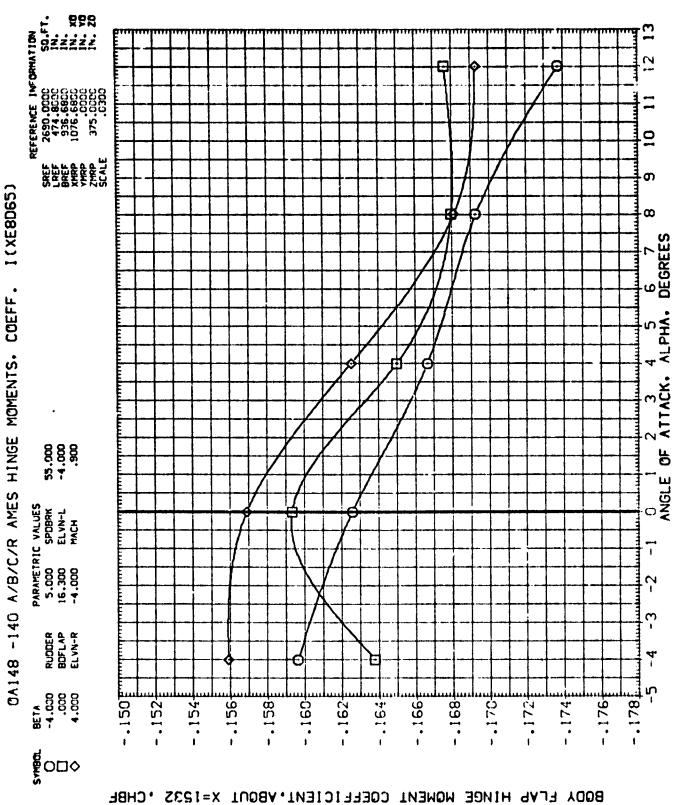
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



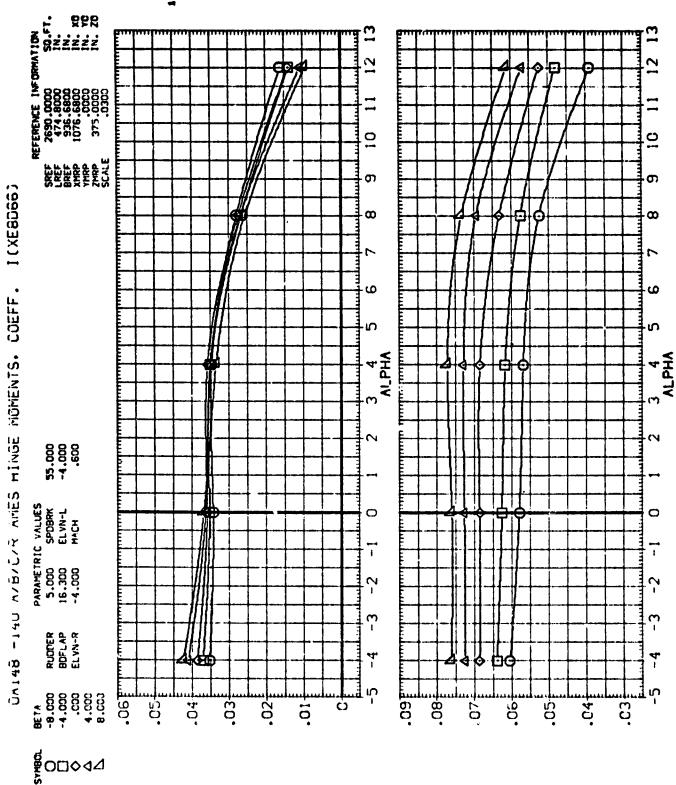
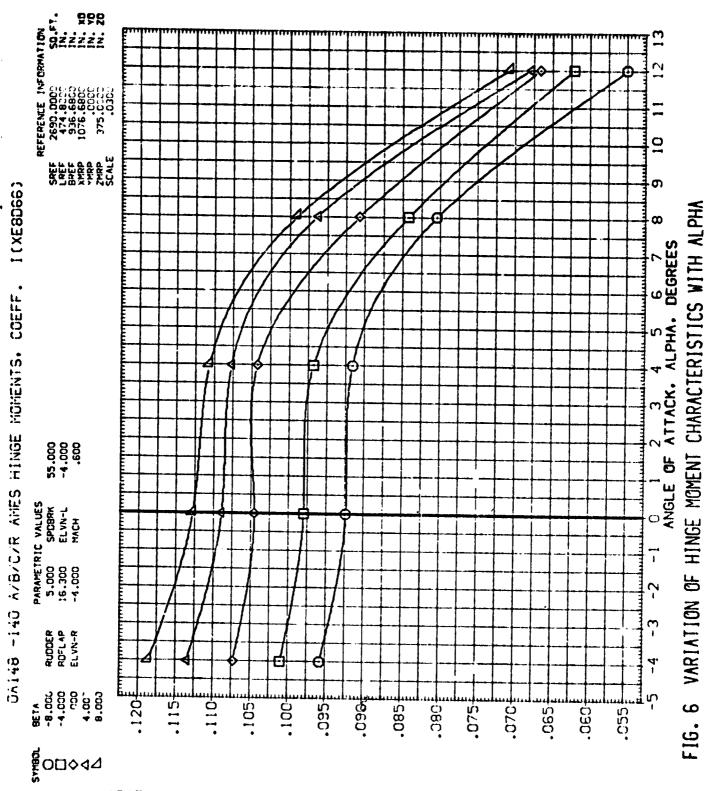


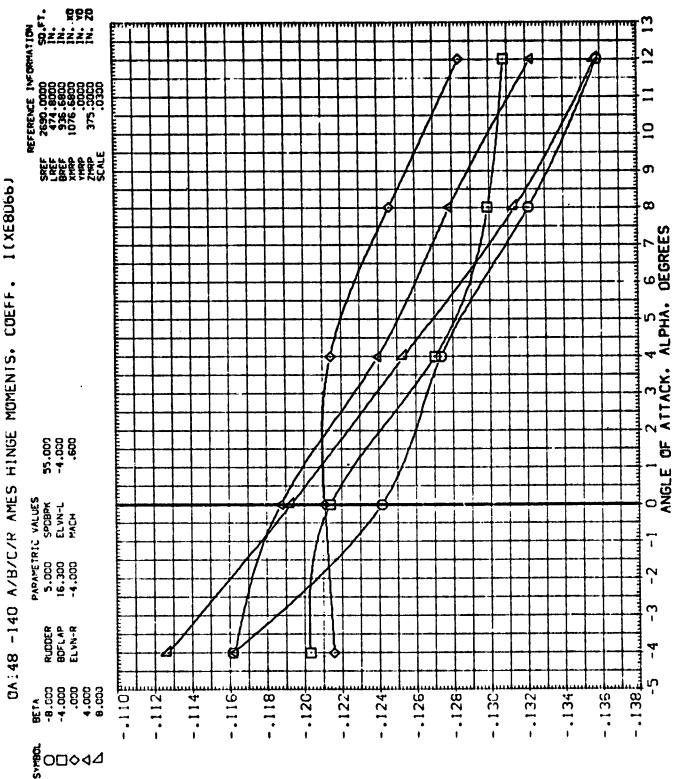
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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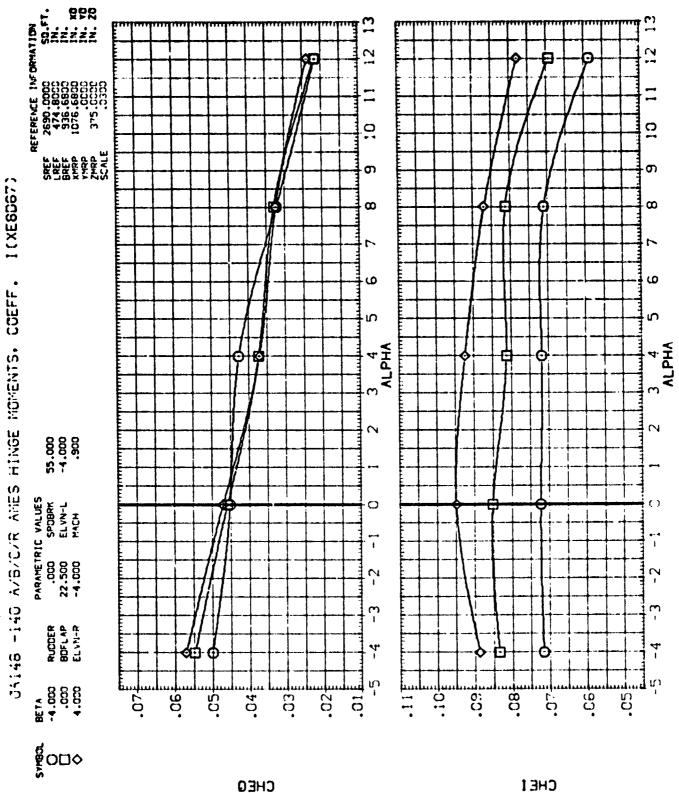


TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT



BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

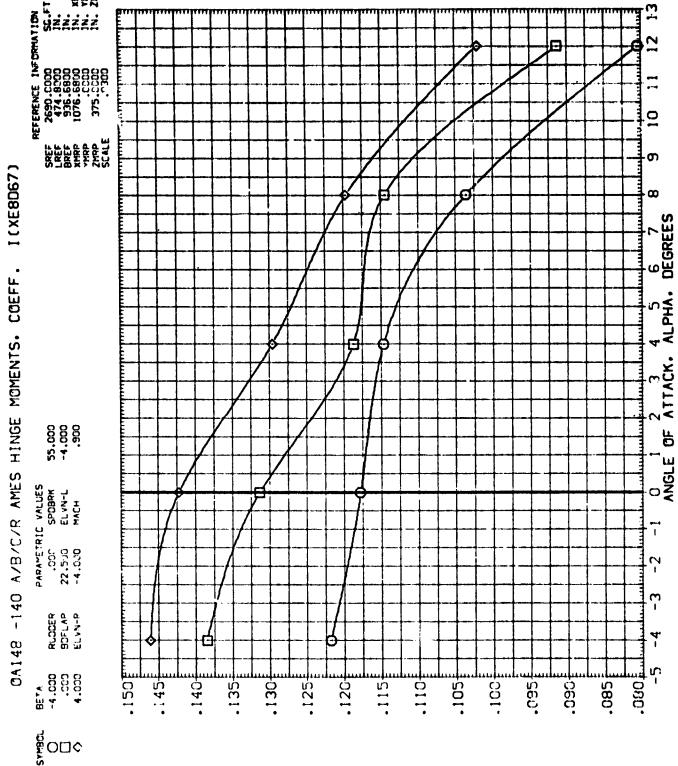
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

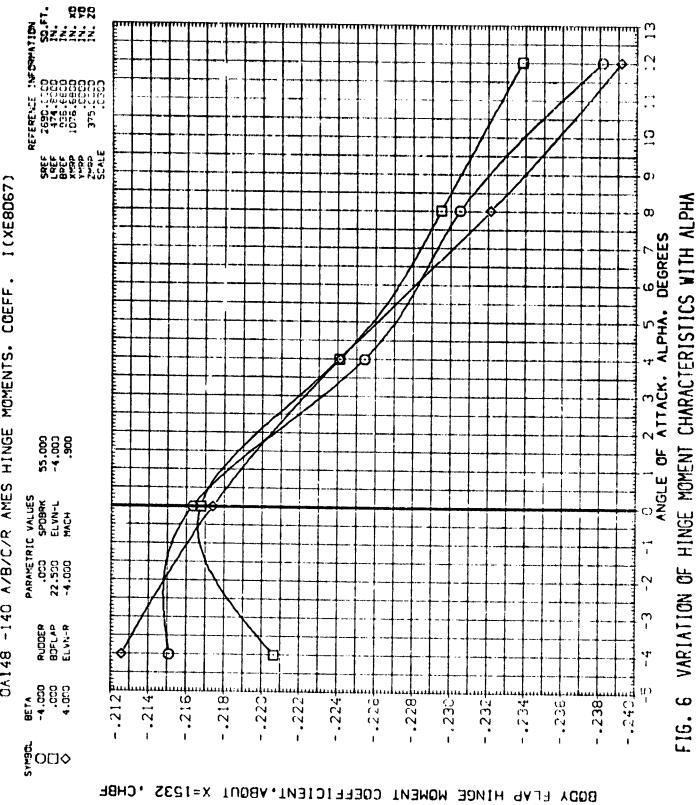
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

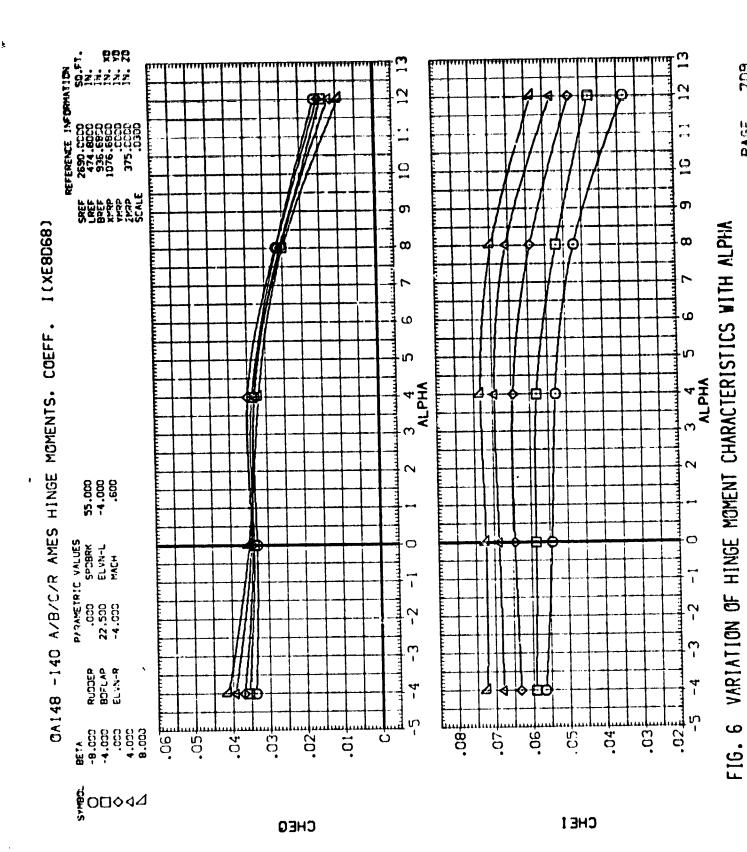
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

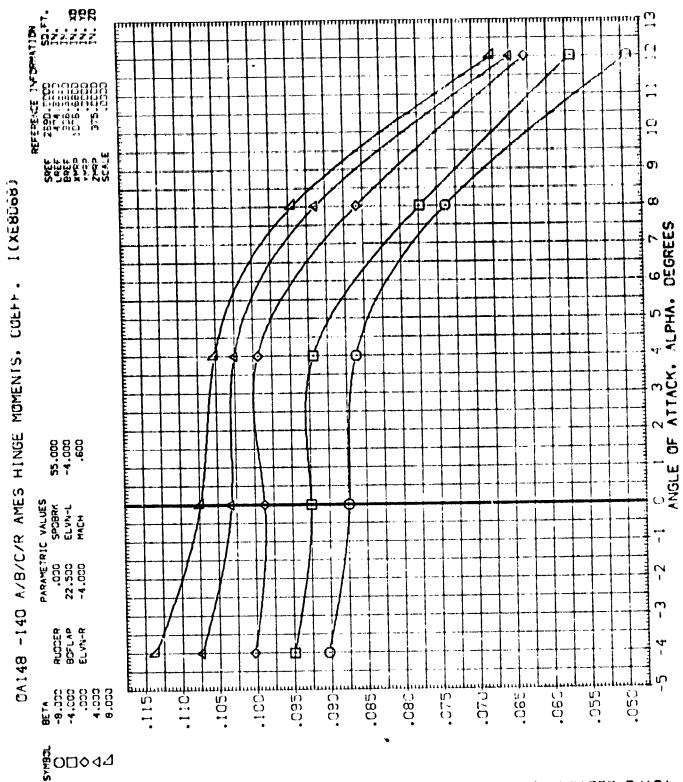
OA148 -140 A/B/C/R AMES HINGE MOMENTS. COEFF. I(XE8D67)



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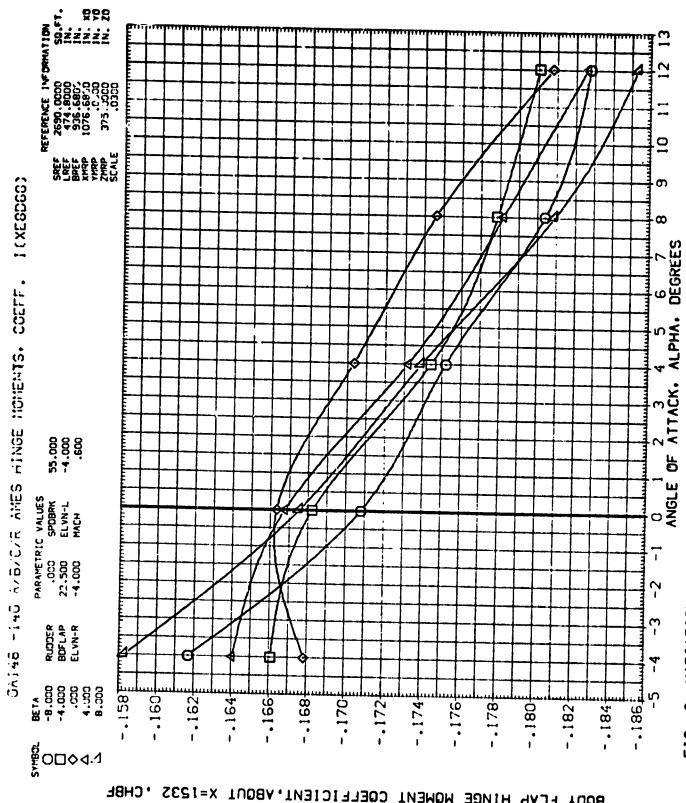




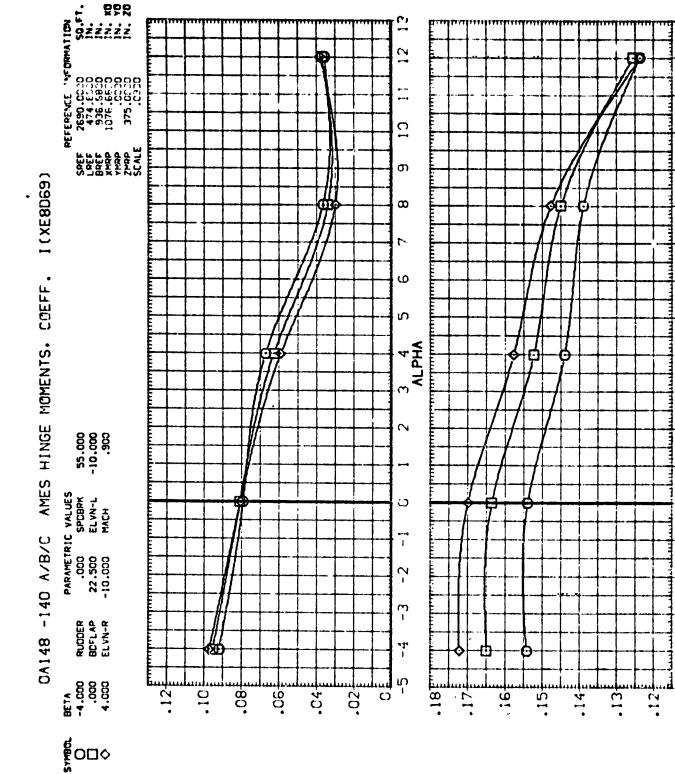
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETUT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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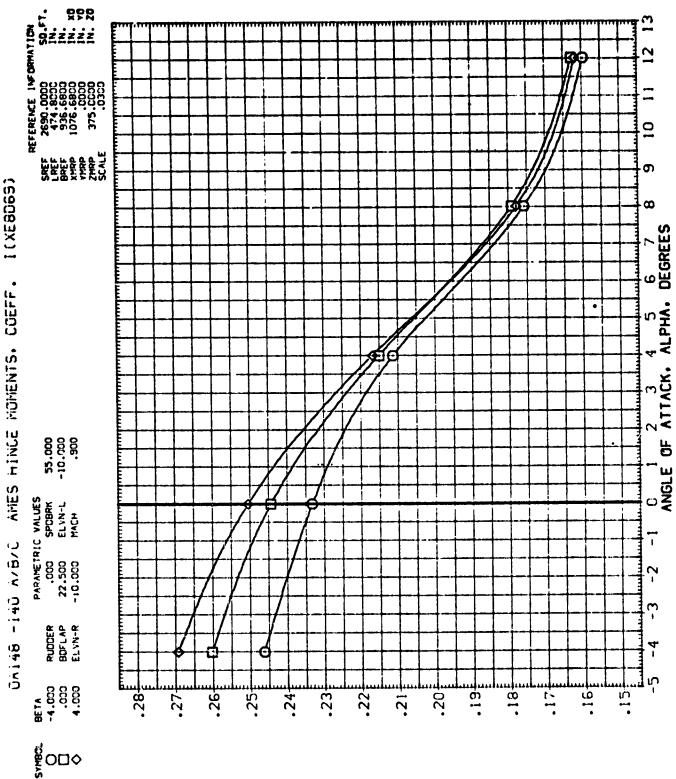
3 4 ALPHA

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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

REFERENCE INFORMATION SO.FT. 7690.000 SO.FT. 174.8: 30 IN. 936.6899 IN. 80 IN. 12 0. SAEF LAEF BAEF XMRP YMRP ZMRP SCALE တ AMES HINGE MOMENTS. COEFF. 1(XE8D69) O 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES 55.000 -10.000 .900 PARAMETRIC VALUES .000 SPOBRK 22.500 ELVN-L -10.000 MACH 0A148 -140 A/B/C 1 -2 <del>ر</del> RUDDER BOFLAP ELVN-R - 190<del>阜</del> 4.000 4.000 4.000 -.195長 -.200<del>[</del> -.210<u>F</u> -.220 E -.245<u>£</u> -.215 -.225<u>+</u> -.230€ -.235<u>+</u> -.250<del>[</del> -.205--.255 -.240-ŽO□◊ BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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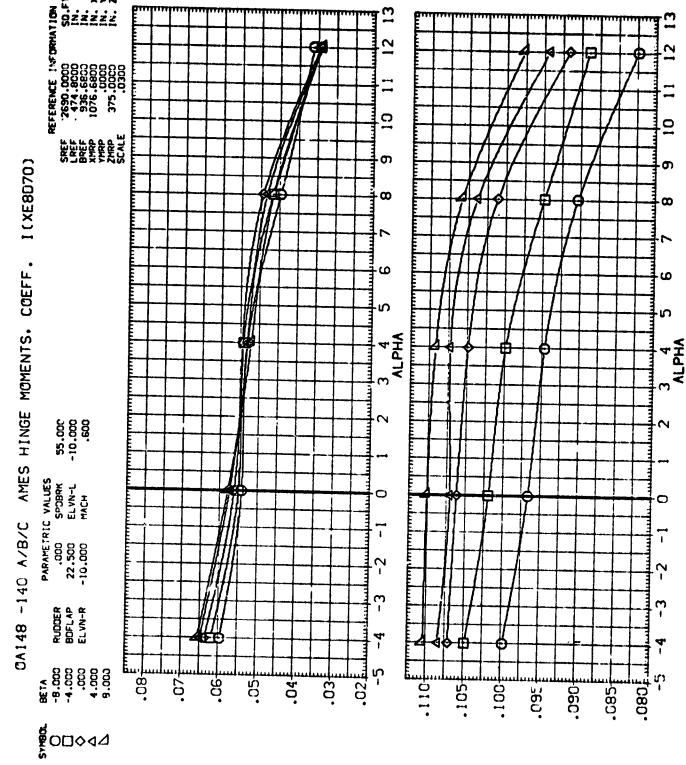


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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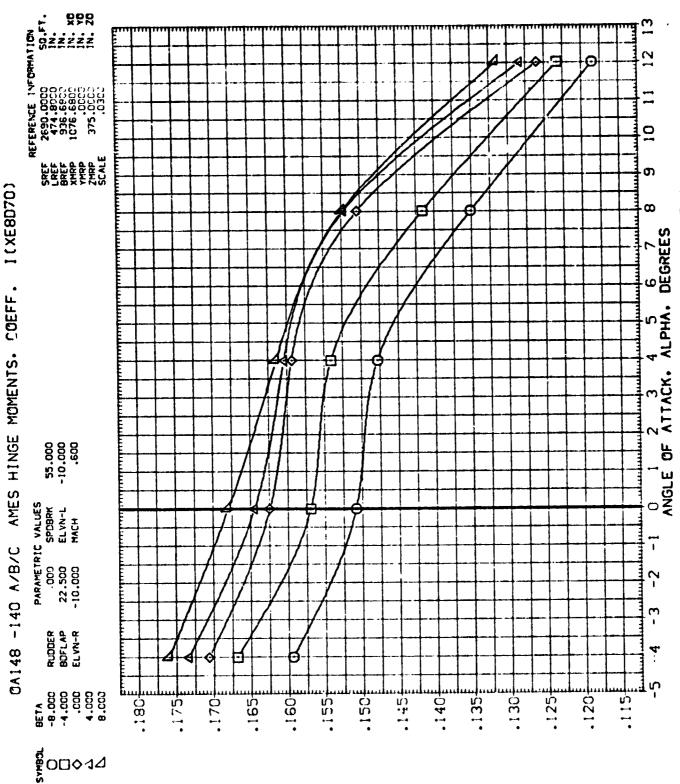
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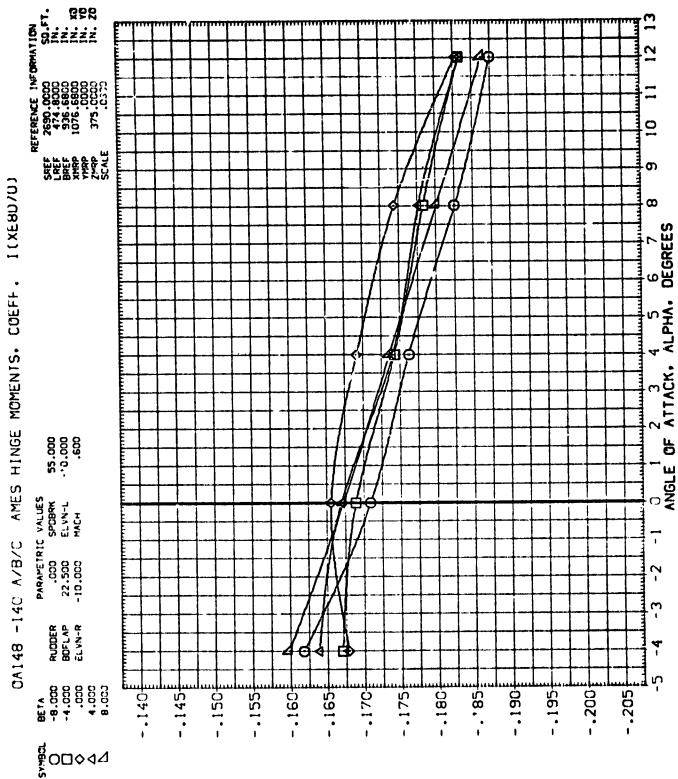
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

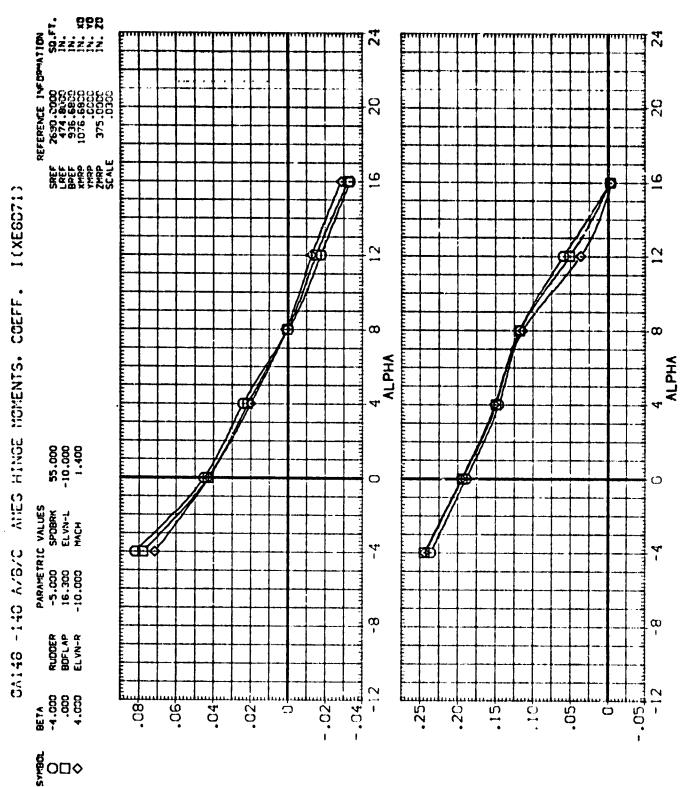
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF



FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



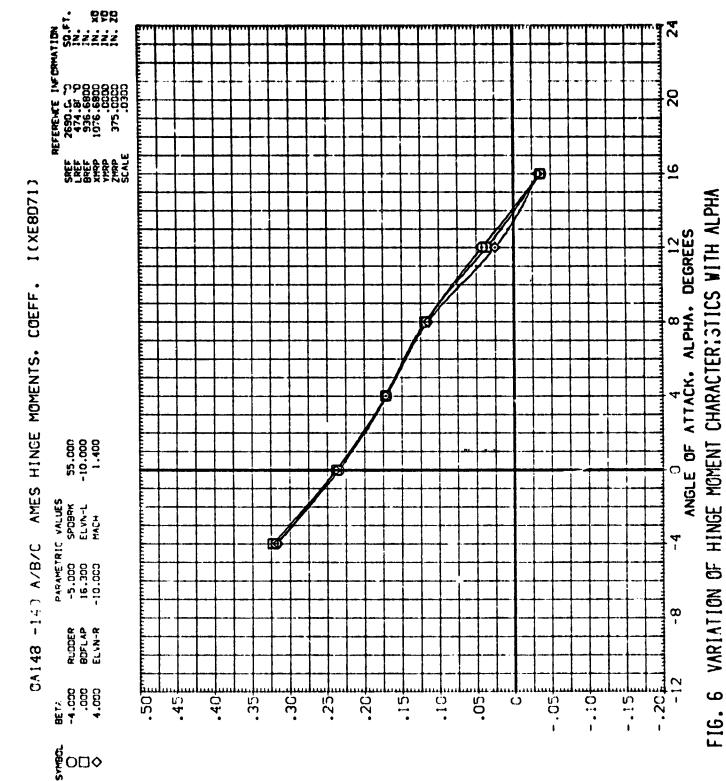
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

REFERENCE IN DRIANT DW 2690 DRIGGE IN. 474.8000 IN. 936.6800 IN. P 1076.6800 IN. M 0.0000 IN. M 0.0000 IN. M 720 PAGE SPEF LREF BREF XMRP YMRP ZMF9 ; 1 (XE8071) FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA ANGLE OF ATTACK. ALPHA. DEGREES AMES HINGE MOMENTS. COEFF. 55.000 -10.000 1.400 PARAMETRIC VALUES
-5.000 SPDBRK
16.300 ELVN-L
-10.000 MACH -**3\*** 04148 -140 A/B/C RUDDER BOFLAP ELVN-R -.30E -.22 -.28 -.12<u>F</u> -.14 - 16 -.18長 -.20<del>[</del> -.24 -.34 - 36 - 38 -.32 -.26 ŘO□◊

BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

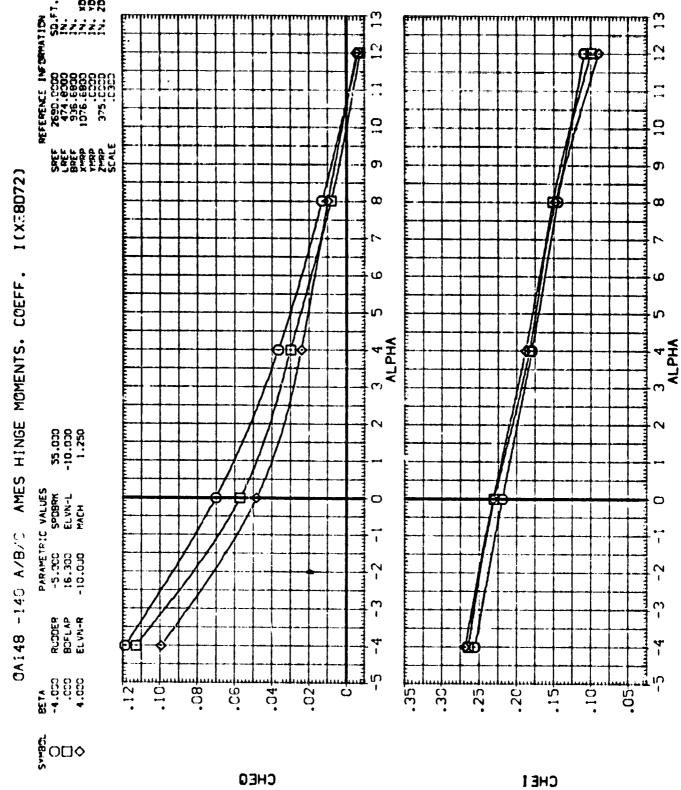
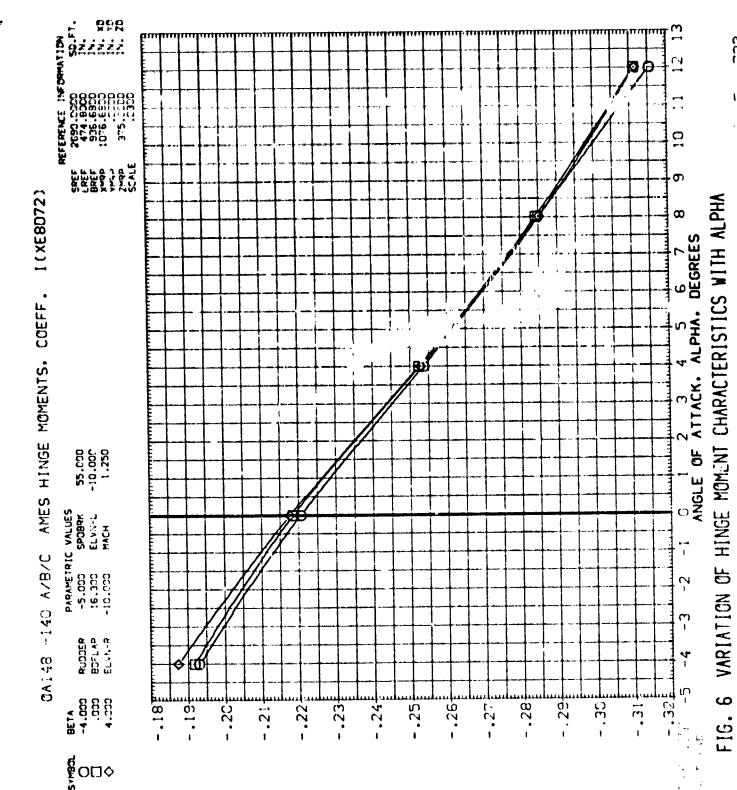


FIG. 6 VIRIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

PEFFECT INFORMATION 26.FT. 474.EDD0 1N. E 936.E8CD 1N. 10.76.E8CD 1N. 2D N 0 Spering Sperin Ø١ ; (XE8F72) ATTACK. ALPHA. DEGREES AMES HINGE MOMENTS. COEFF. 55.000 -10.000 1.250 ANSLE OF PARAMETRIC VALUES
-5.000 SPDB9K
16.300 ELVN-L
-10.000 MACH GA148 -140 A/B/C ---PUDDER BOFLAP ELVN-R .60F **-4**0₽ -4.000 -000 -2.000 15 一.10点 .55<u>F</u> 35. (4) (1) -20th -10<del>6</del> -.05 45 30F. 52 .05  $\mathbf{C}$ Ş O□◊

TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. S VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

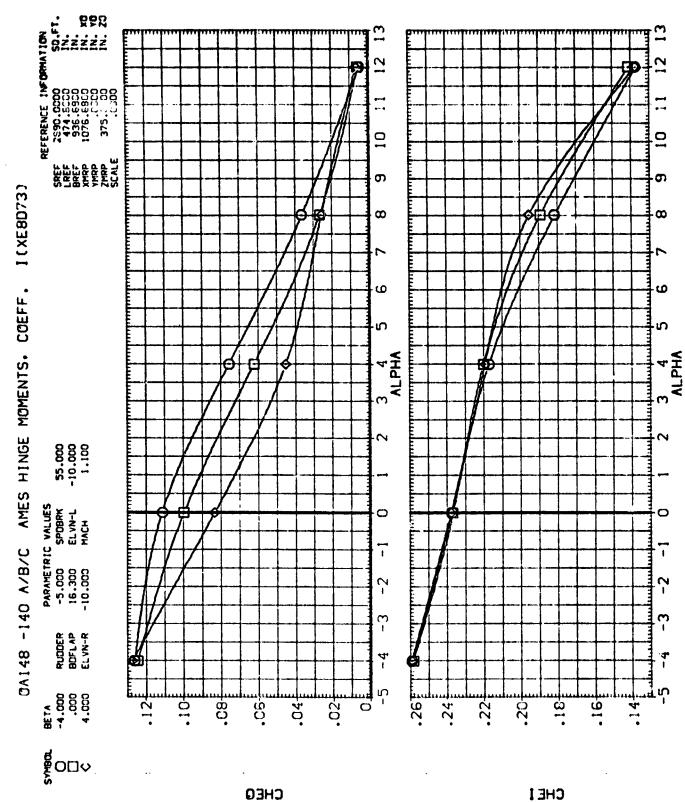
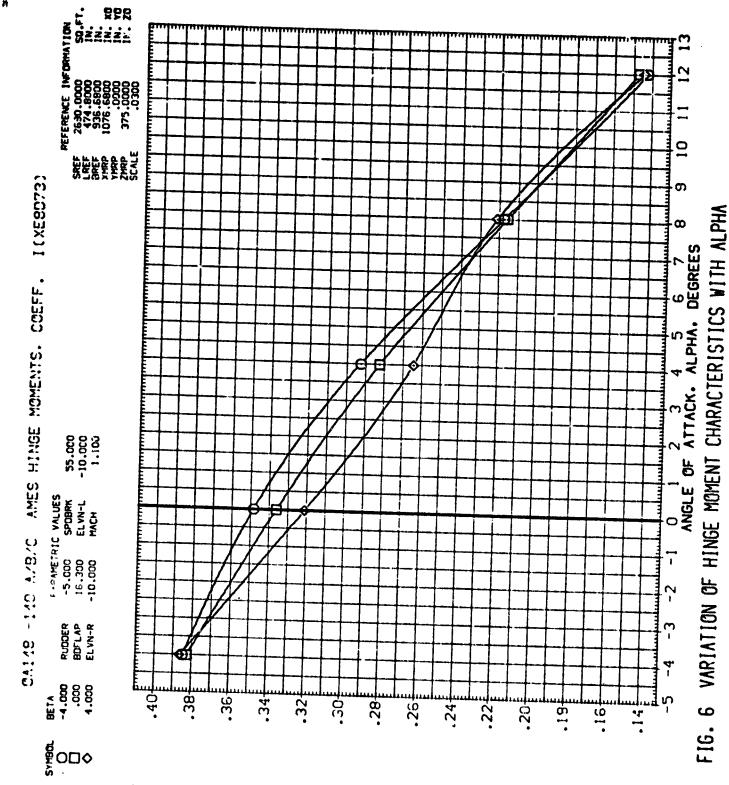


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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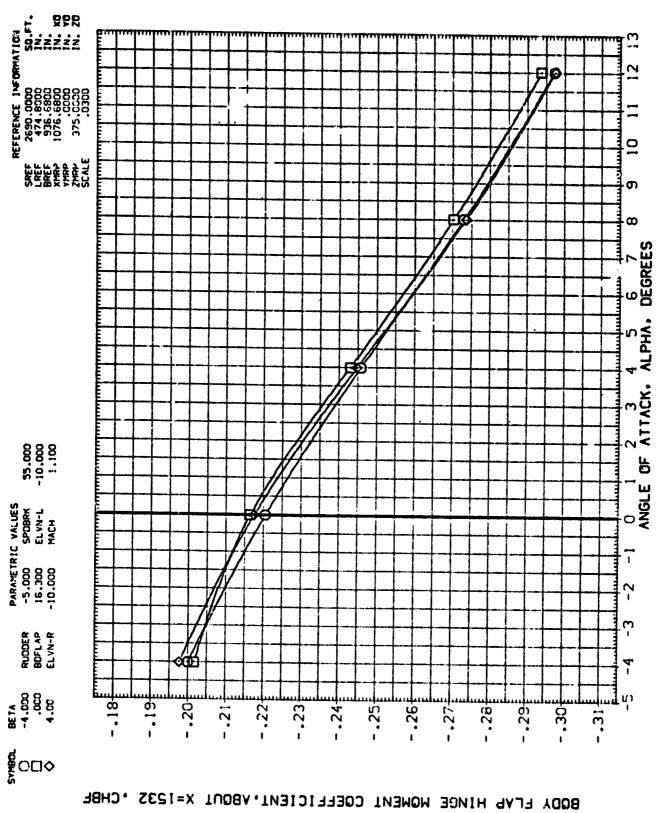
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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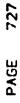


VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA F16. 6

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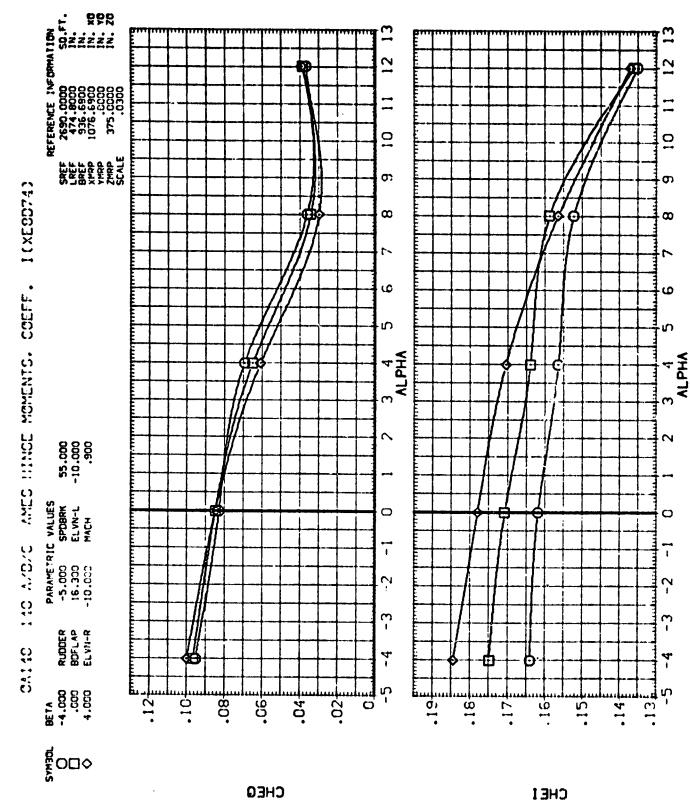
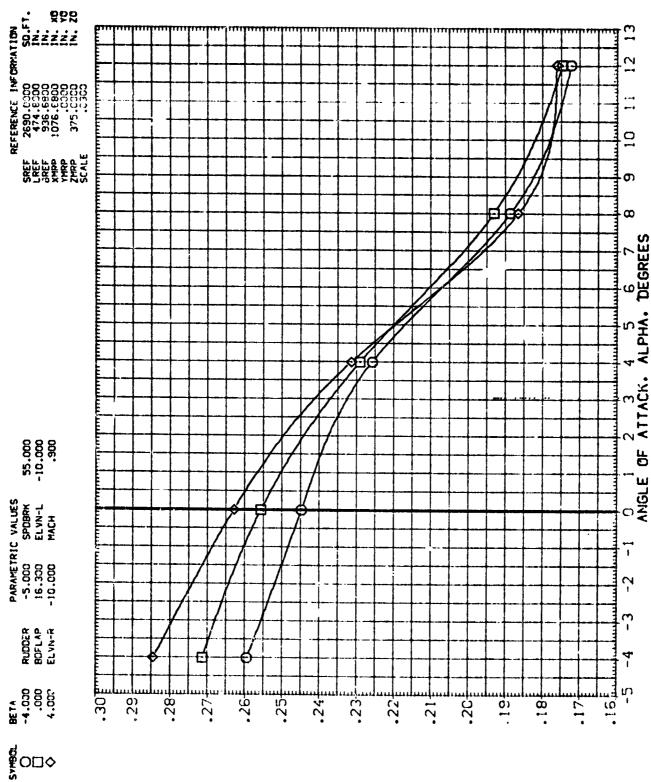


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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TOTAL ELEVON HINGE MOMENT COEFFICIENT. ABOUT X=1387, CHETOT

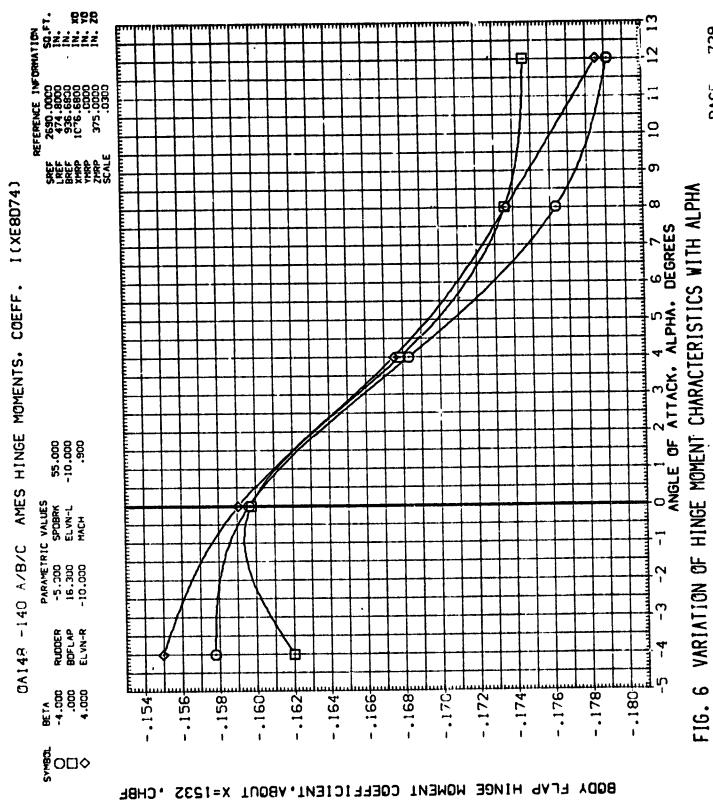
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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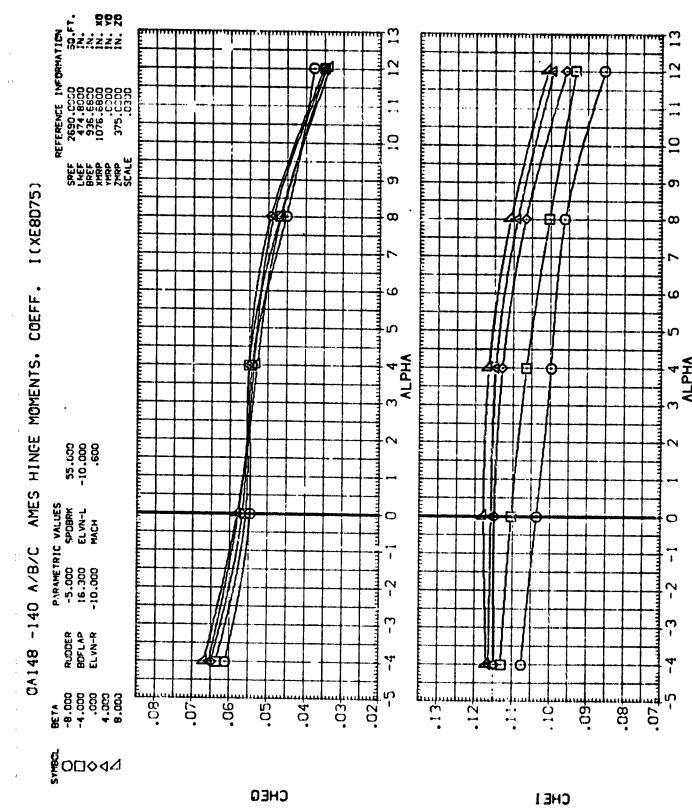
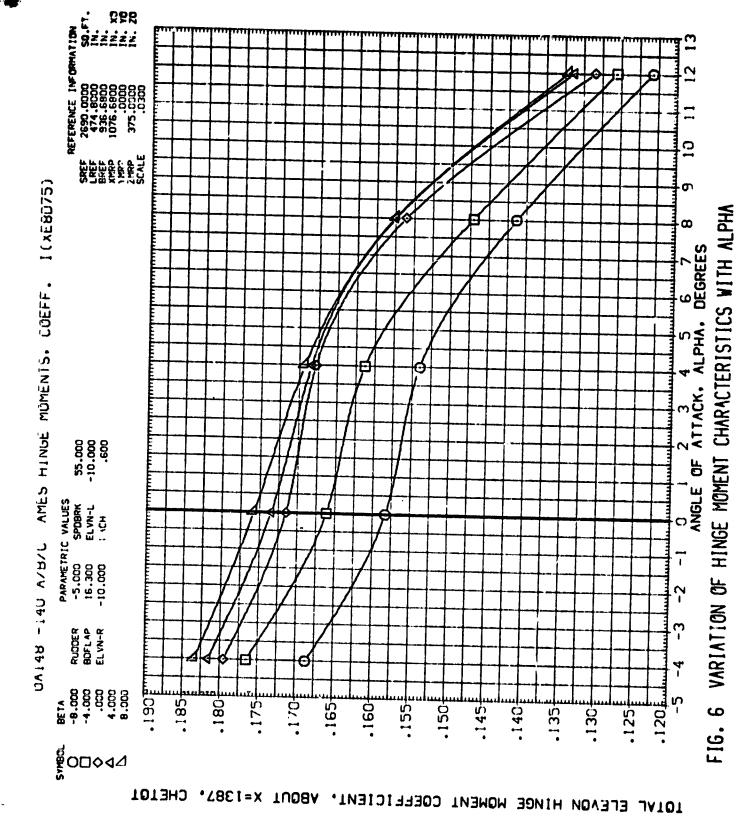
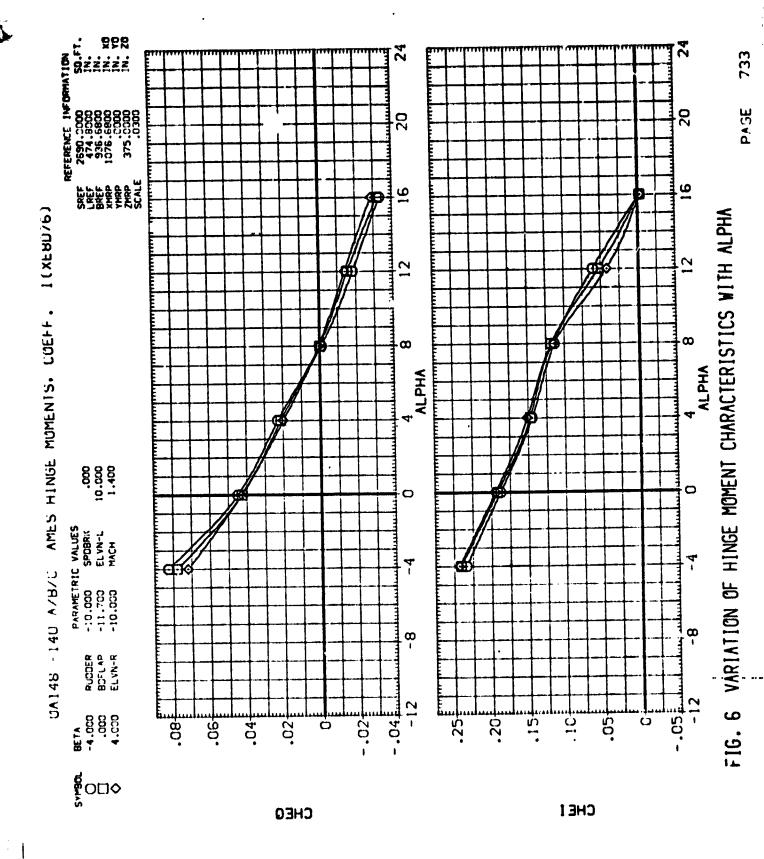


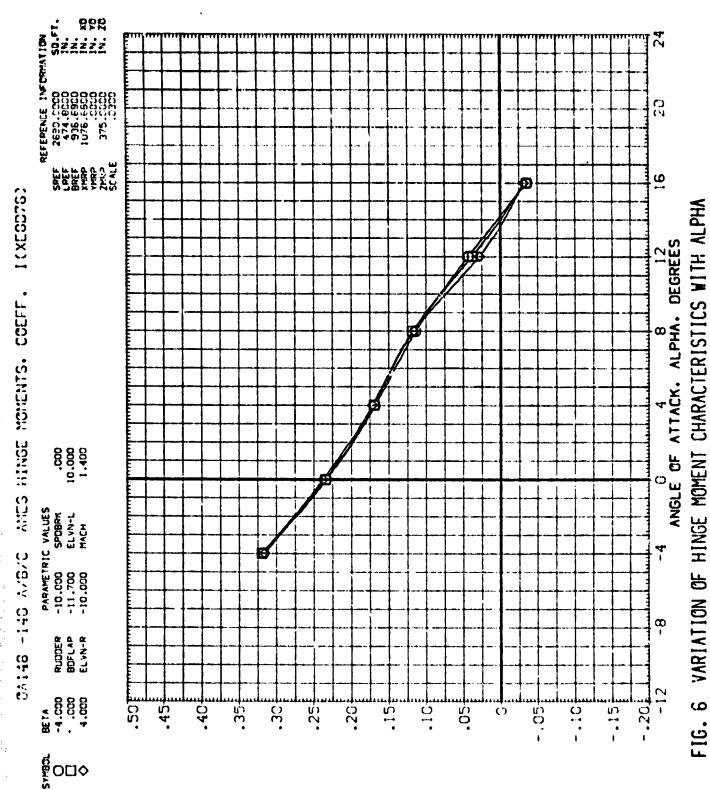
FIG. 6 VARIATION OF HINGE MOMENI CHARACTERISTICS WITH ALPHA



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474.8000 IN.
F 936.6800 IN. x0
P 176.6800 IN. x0
P 375.0000 IN. 20 12 2690.0000 474.8000 936.6800 1376.6800 375.0000 0 SAEF LAEF BREF XMAP YMAP ZMAP SCALE 1 (XE8075) ത O 1 2 3 4 5 6 7 ANGLE OF ATTACK. ALPHA. DEGREES AMES HINGE MOMENTS. COEFF. 55.000 -10.000 .600 PARAMETRIC VALUES -5.000 SPDBRK 16.300 CLVN-L -10.000 MACH CA110 -110 A/B/C : -2 <u>ب</u> RUDDER BOFLAP ELVN-R -.100<u>₽</u> 量501.-8-600 -4.000 -4.000 -4.000 -4.000 -8.000 -.135長 -.140<u>=</u> <u> - 133</u> - 145부 -.110 -.115 -.:20<u>E</u> -.125₽ - .165長 -.150 - 155 -.160 **№**0□◊4**7** BODY FLAP HIGGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA





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AMES HINGE MOMENIS. COEFF.

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RUDDER BOFLAP ELVN-R

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-.315<u>F</u> .325 型010· ₹500°--020年 到510. -.010₽ -.025 -.030<u>-</u> 13CO. -.020 8007 FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532

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PEFERENCE INFCRMATION 20.FT. F 474.5000 IN. ED 1075.EBD0 9 C SCALE SCALE SCALE SCALE SCALE ຫ I (XE8077) œ COEFF. (0 HINGE MOMENTS. 3 4 ALPHA .030 10.000 1.250 AMES PARAMETRIC VALUES -10.030 S70B9K -11.700 ELVN-L -10.030 MACH  $\Box$ 3 **→** JA148 -140 A/B/C 7 رن رن RUDDER BOFLAP ELVN-R 7, M -4.000 -000 4.000 .ф. З 150 th 200 C 30 30 Ó ξ Q Q Q CHEO CHE I

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VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA 3 4 ALPHA FIG. 6

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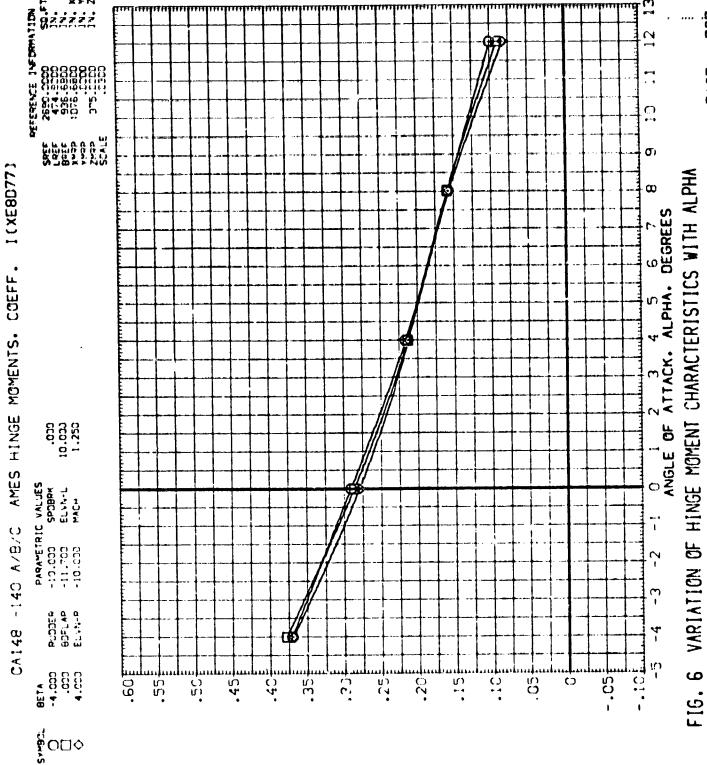
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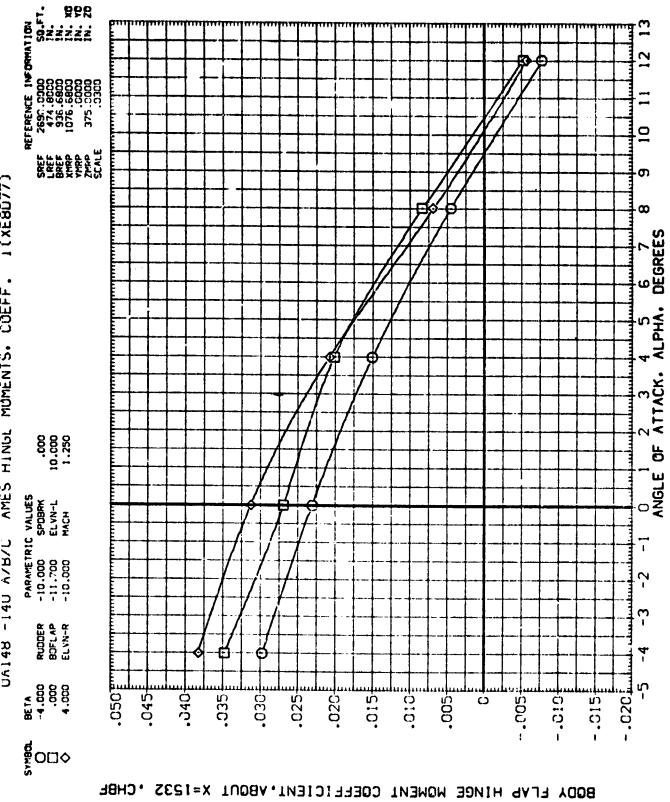
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

AMES HINGL MUMENIS. COEFF. 1(XE8077) UA148 -14U A/B/U



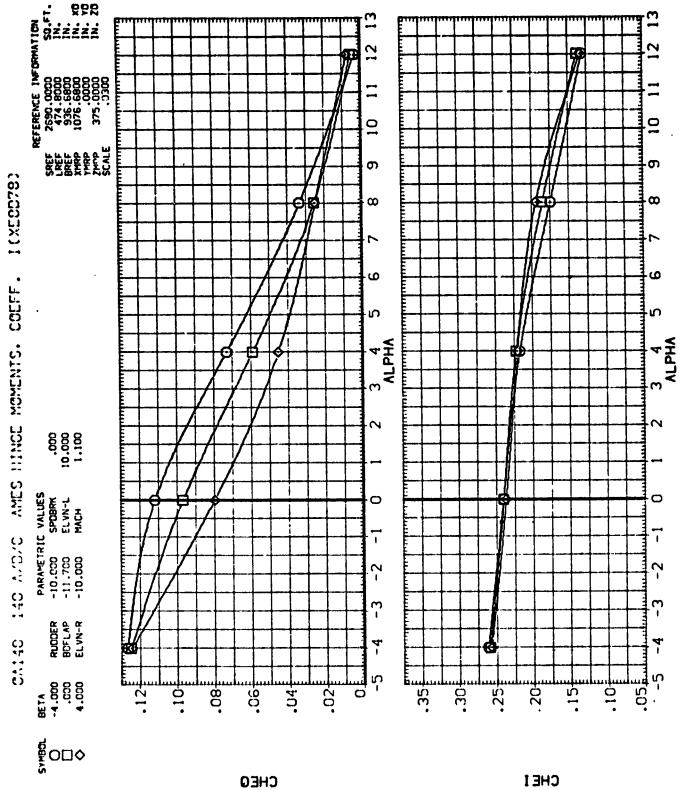
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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

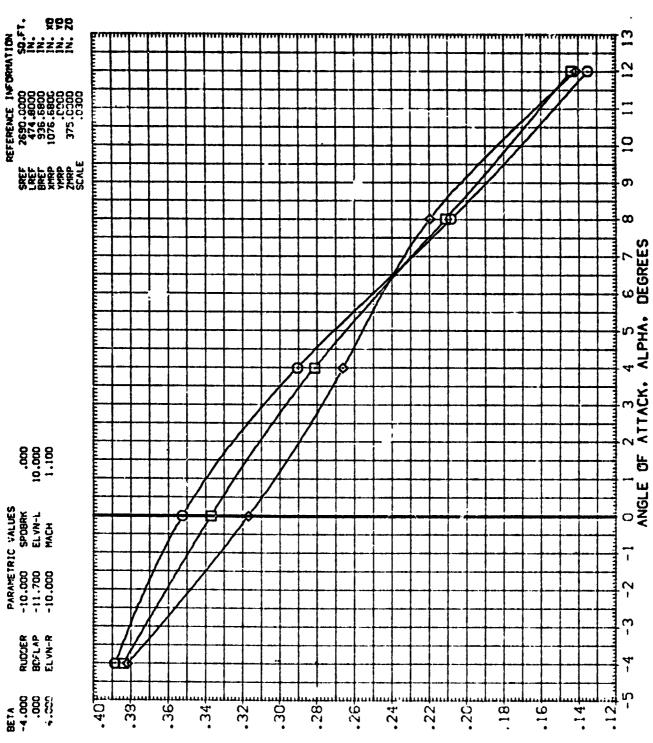


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

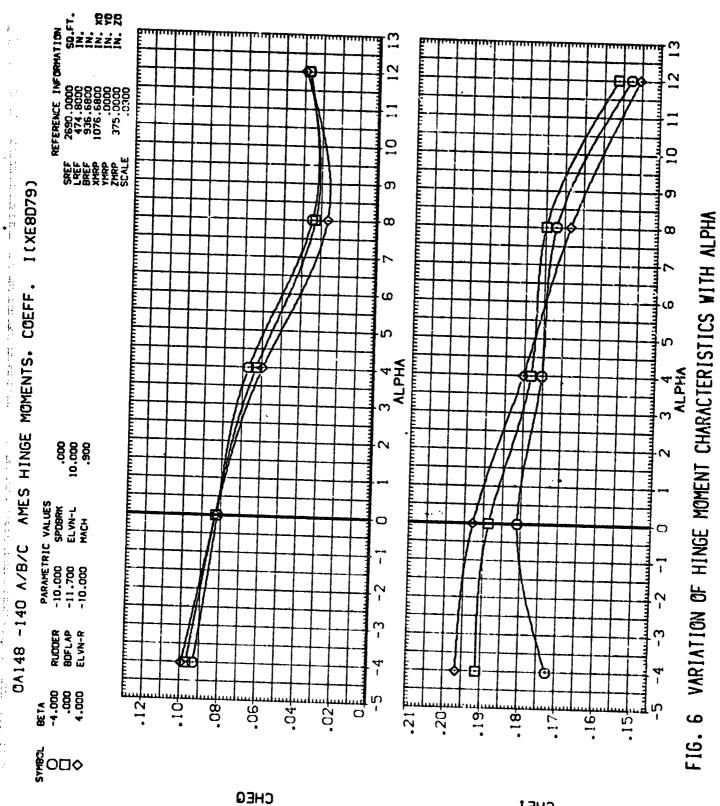
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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REFERENCE INFORMATION
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936.6800 1N.
1076.6800 1N. XI 0 SREF LREF BREF XHRP YHRP SCALE 1 (XE8078) O 1 2 3 4 5 6 7 ANGLE OF ATTACK. ALPHA. DEGREES AMES HINGE MUMENIS. CUEFF. 10.000 PARAMETRIC VALUES
-10.000 SPOBRK
-11.700 ELVN-1. UA148 -140 A/B/C RUDDER BOFLAP ELVN-R .054 86.7A -4.000 .000 4.000 .038₽ 到050. -028 .046年 .034<del>₽</del> .032 .048<del>[</del> .044卡 .036€ .052長 .050 .042 .04C § 6 0□◊

BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

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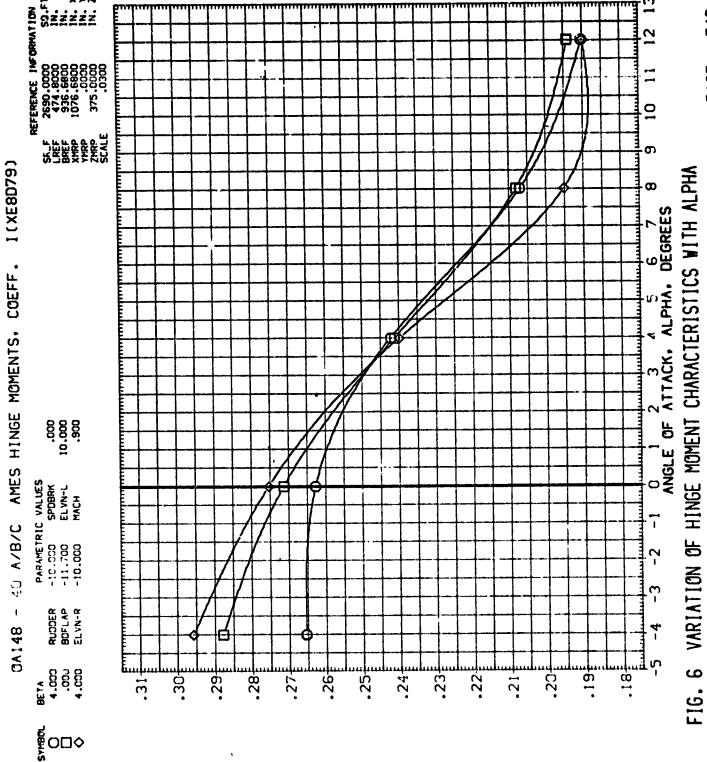


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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

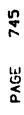
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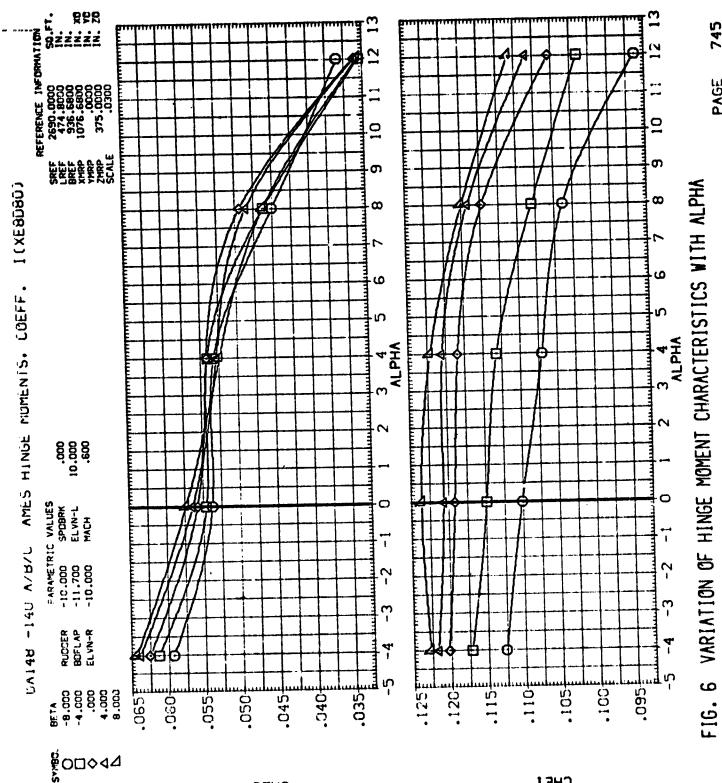
REFERENCE INFORMATION 12 2693.0000 474.8000 936.6800 1076.6600 375.0000 2 SREF LREF KHRP VHRP ZHRP SCALE ٥ŋ I (XE8D79) Ø O 1 2 3 4 5 6 7 ANGLE OF ATTACK, ALPHA, DEGREES HINGE MOMENTS. COEFF. .00.00 .00.00 .000.00 AMES PARAMETRIC VALUES -10.000 SPOBRK -11.700 ELVN-L -10.000 MACH CA148 -140 A/B/C 7 7 ٣-RUDDER BOFLAP ELVN-R -.010 .090· -4.000 -9.000 -4.000 .045분 .025 <u>-055</u>€ 一050. -010· .015年 .040E .035 空0至0 -005<u>+</u> -.005 6 Ž O□♦ BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF

VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA FIG. 6

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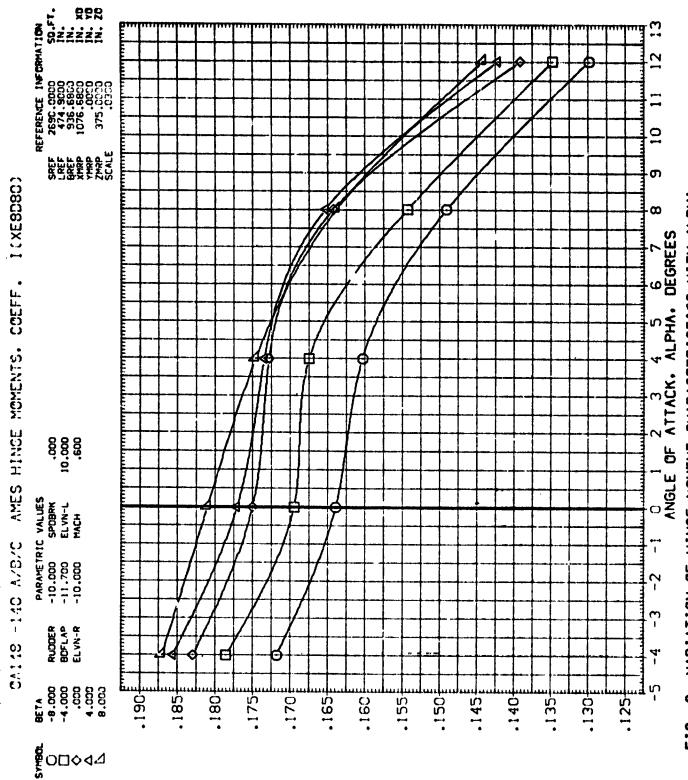




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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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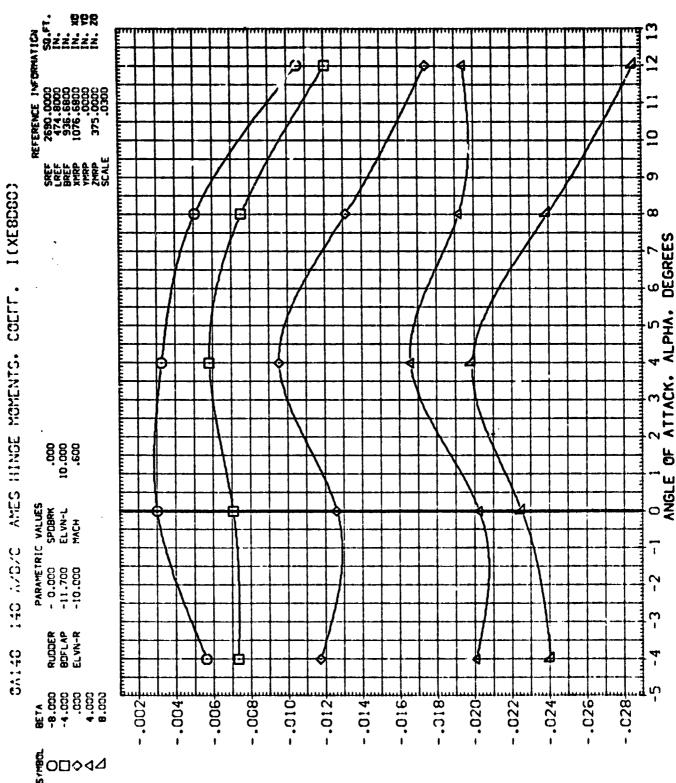


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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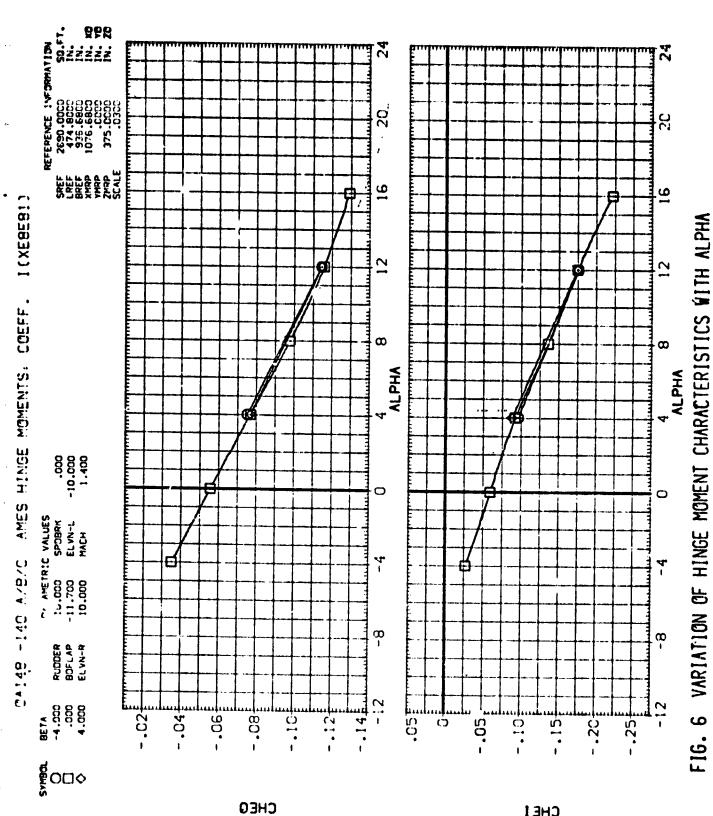


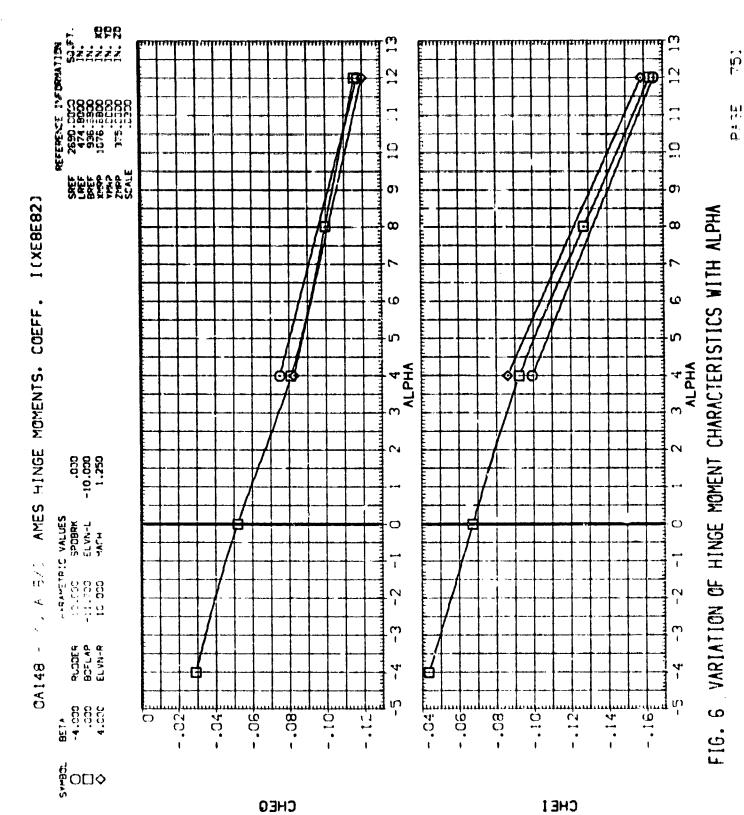
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

REFERENCE INFORMATION
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F 936.6800 IN.
P 1076.6800 IN. XD
P 375.0000 IN. ZD
E 375.0000 IN. ZD SREF LREF RREF XMRP TN:3P ZMRP SCALE 1 (XE8E81) O 4 8 12 ANGLE OF ATTACK. ALPHA. DEGREES AMES HINGE MOMENTS. COEFF. PARAMETRIC VALUES 10.000 SPOBRM -11.700 ELVN-L 10.000 MACH CA148 -140 A/B/C RUGDER BOFLAP ELVN-R .15智 # 198 9.000 9.000 9.000 9. -.20€ -05F -.05 - .10長 -.25₽ -.35 - .40₹ - 15<u>m</u> - 30<u>E</u> -.45 \$ 0□◊

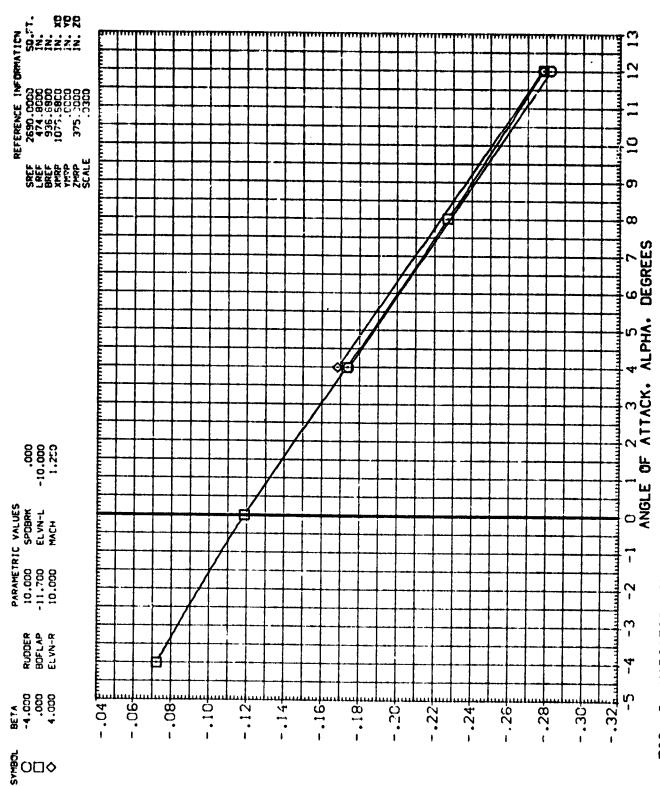
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

2651 0000 80. FT. 2650 80. FT. ا ا ا 9 I (XE8E81) FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS AITH ALPHA ANGLE OF ATTACK. ALPHA. DEGREES DA148 -140 A/B/C AMES HINGE MOMENTS. COEFF. -10.000 -1.400 PARAMETRIC VALUES 10.000 SPOBRK -11.700 ELVN-L 10.000 MACH 4 RUDDER BDFLAP ELVN-R -.035Ё - 030 .035配 0.5 О Сі Сі . . . . #£1.4 .000 4.000 4.000 <u> 1030</u> -025年 -.ਹ20₹ -,025<u></u> -.015 -.003 -.01C Ò Ž OП♦

BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CHBF



OA148 -140 A/B/C AMES HINGE MOMENTS. COEFF. I(XE8E82)



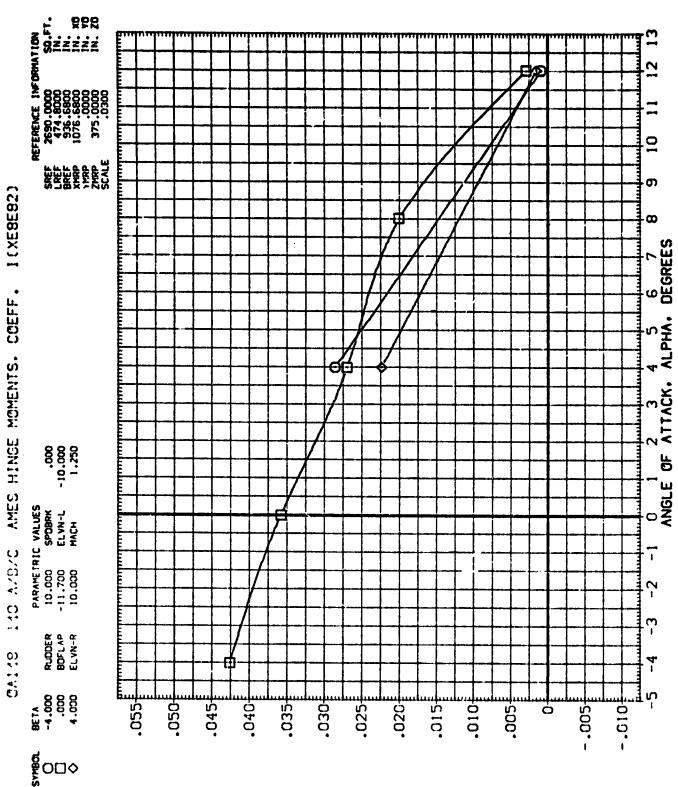
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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BODY FLAP HINGE MOMENT COEFFICIENT, ABOUT X=1532 , CH8F



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FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

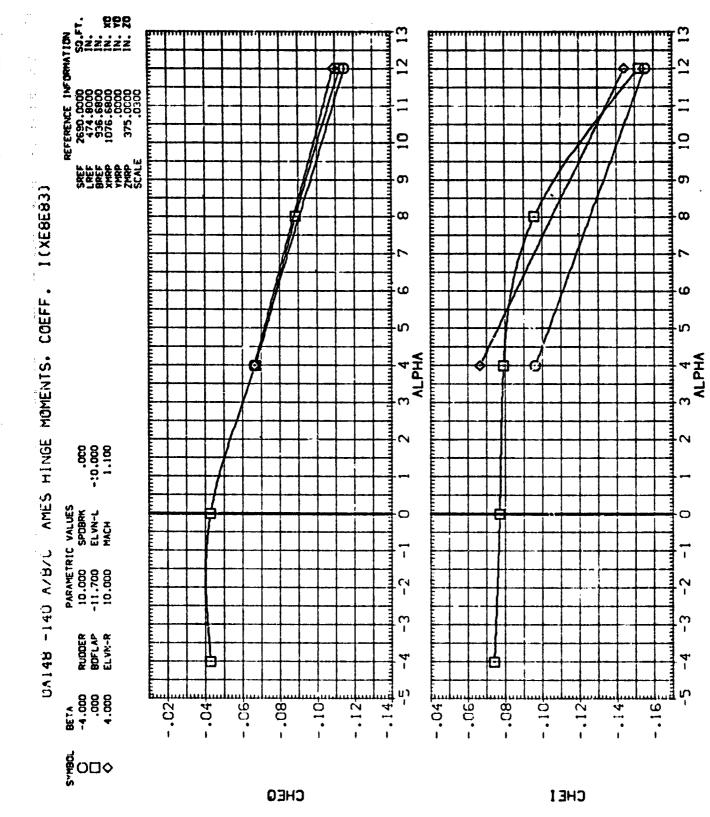
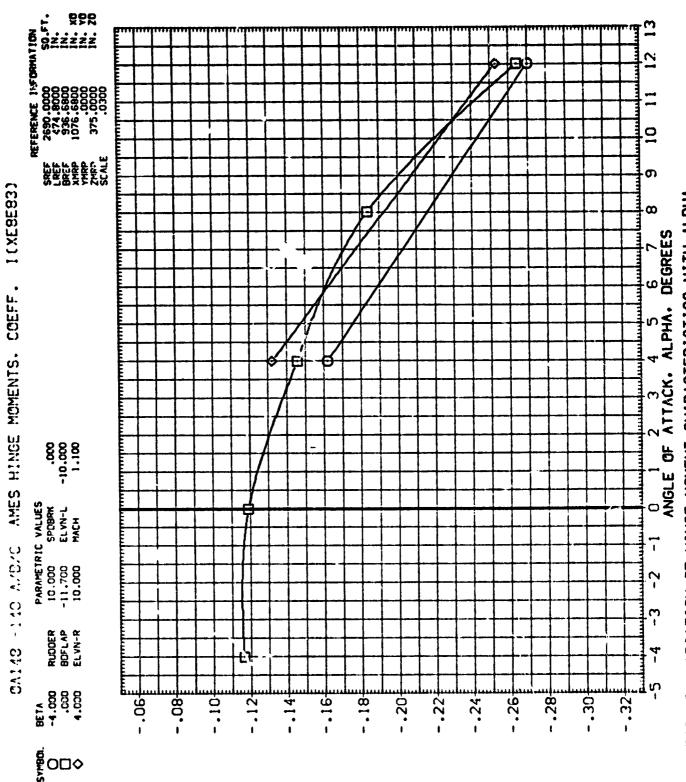


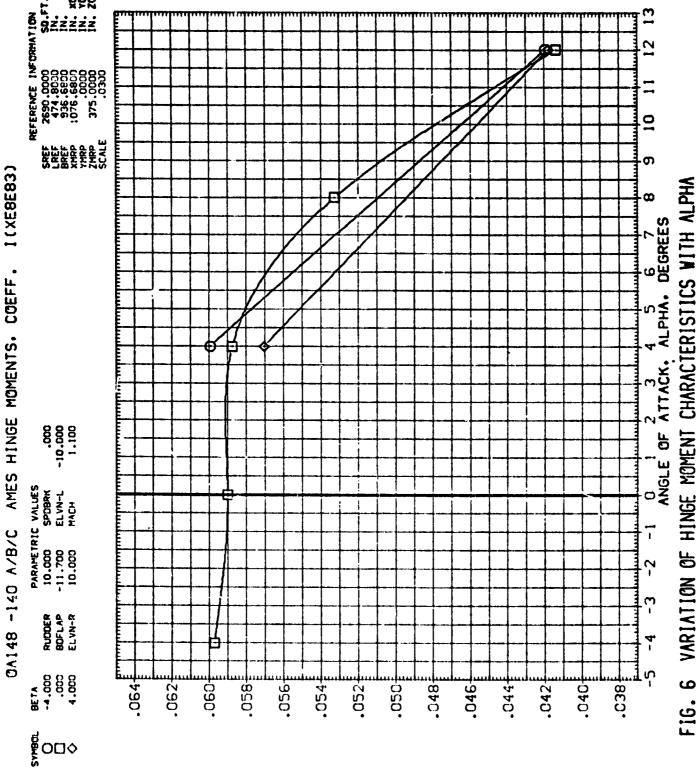
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA



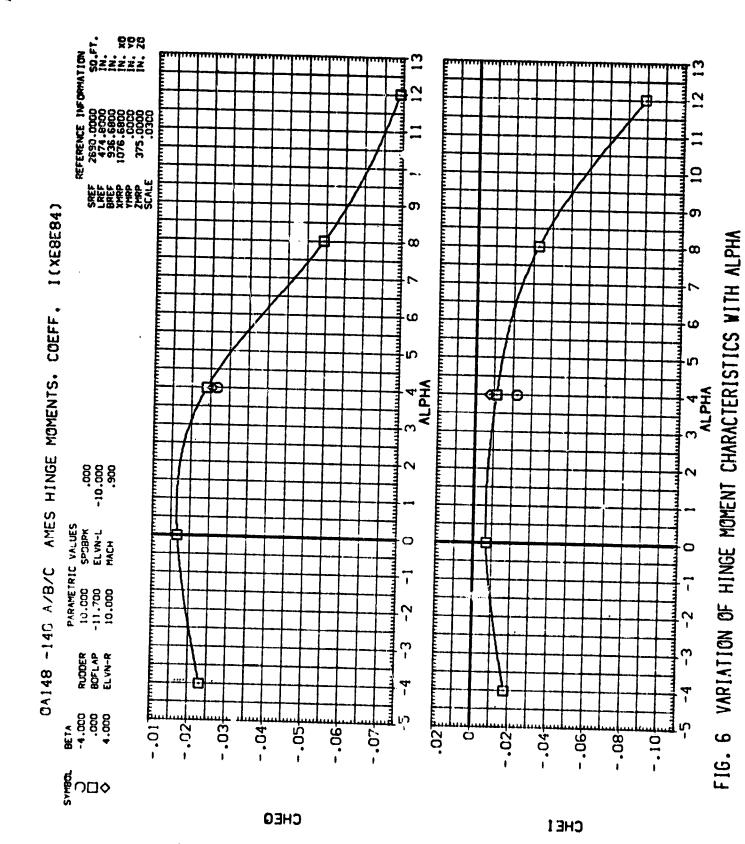
TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

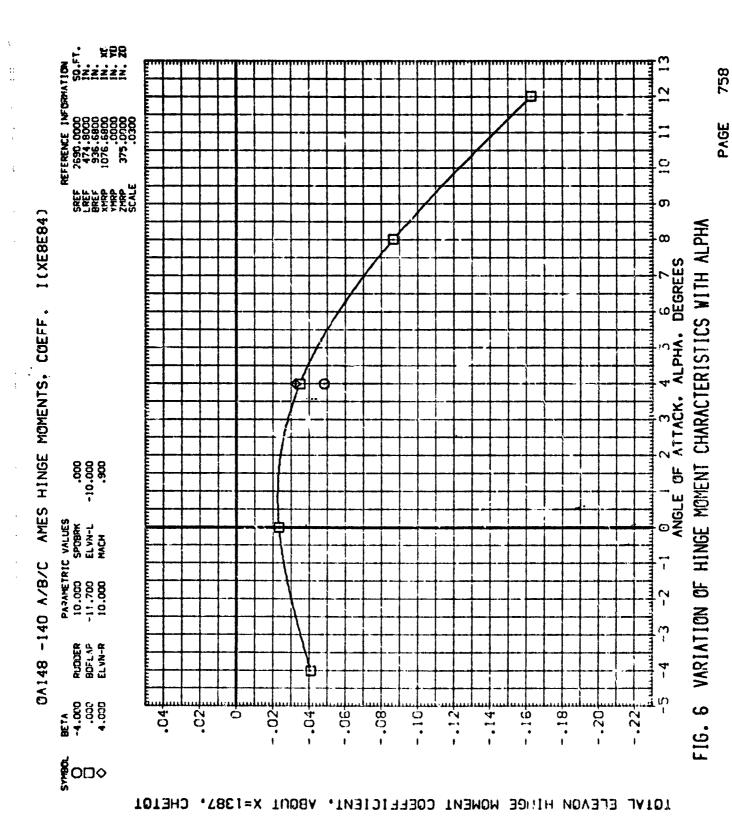
FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

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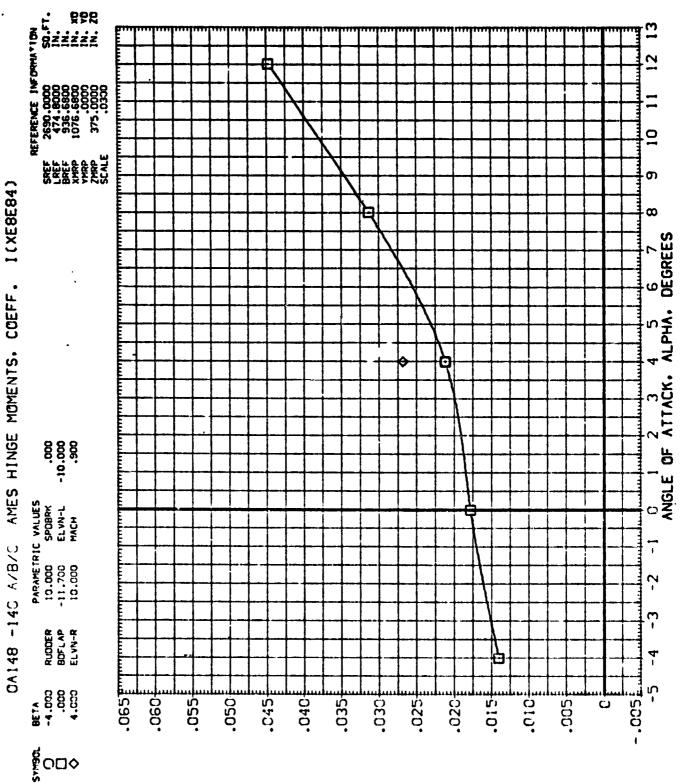


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

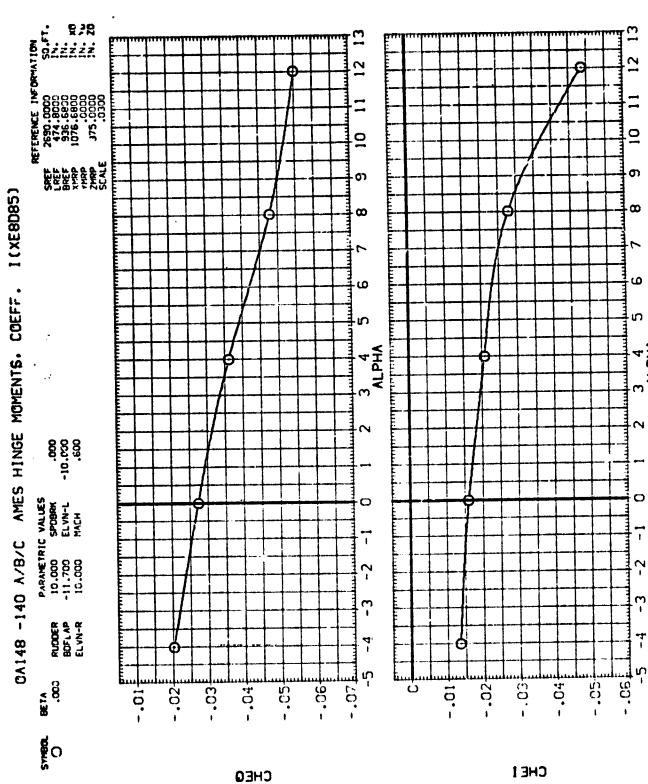


FIG. 6 VARIATION OF HINGE MOMENT CHARACTERISTICS WITH ALPHA

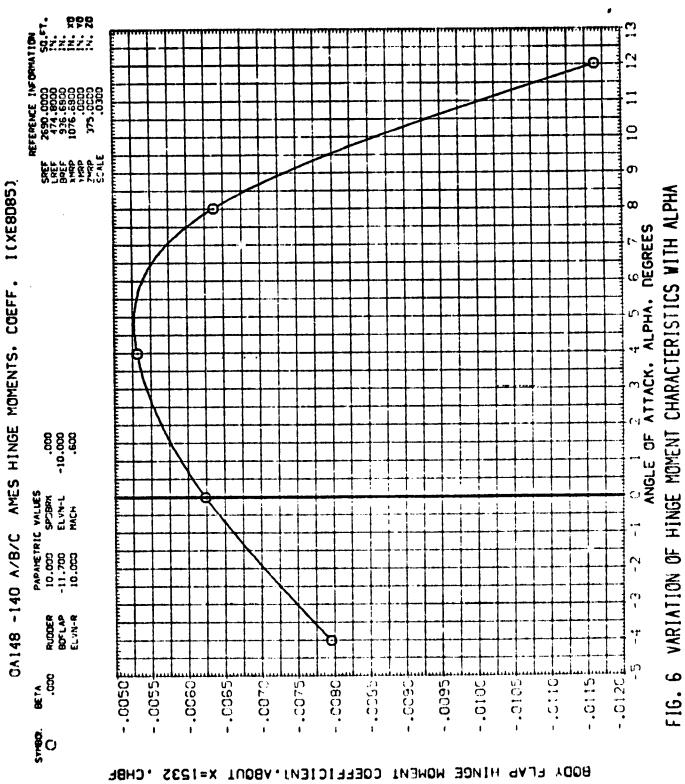
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TOTAL ELEVON HINGE MOMENT COEFFICIENT, ABOUT X=1387, CHETOT

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